

Development, Validation, and Application of OSSEs at NASA/GMAO

Ronald Errico
Nikki Privé

Goddard Earth Sciences Technology and Research Center
at Morgan State University

and

Global Modeling and Assimilation Office
at NASA Goddard Space Flight Center



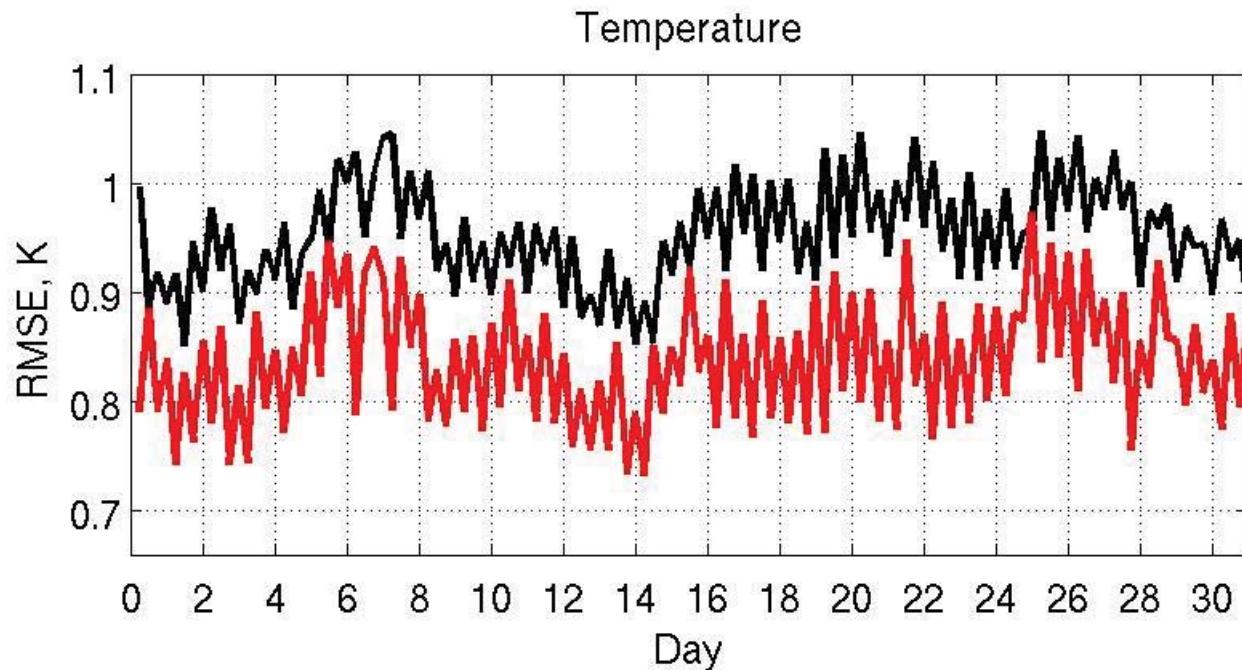
Outline:

1. Impacts of 4x daily radiosondes everywhere
2. Impacts of Micromas CubeSat
3. Estimate of analysis error characteristics
4. Examination of the “NMC Method”
5. Effects of model and observation errors
6. Examination of predictability

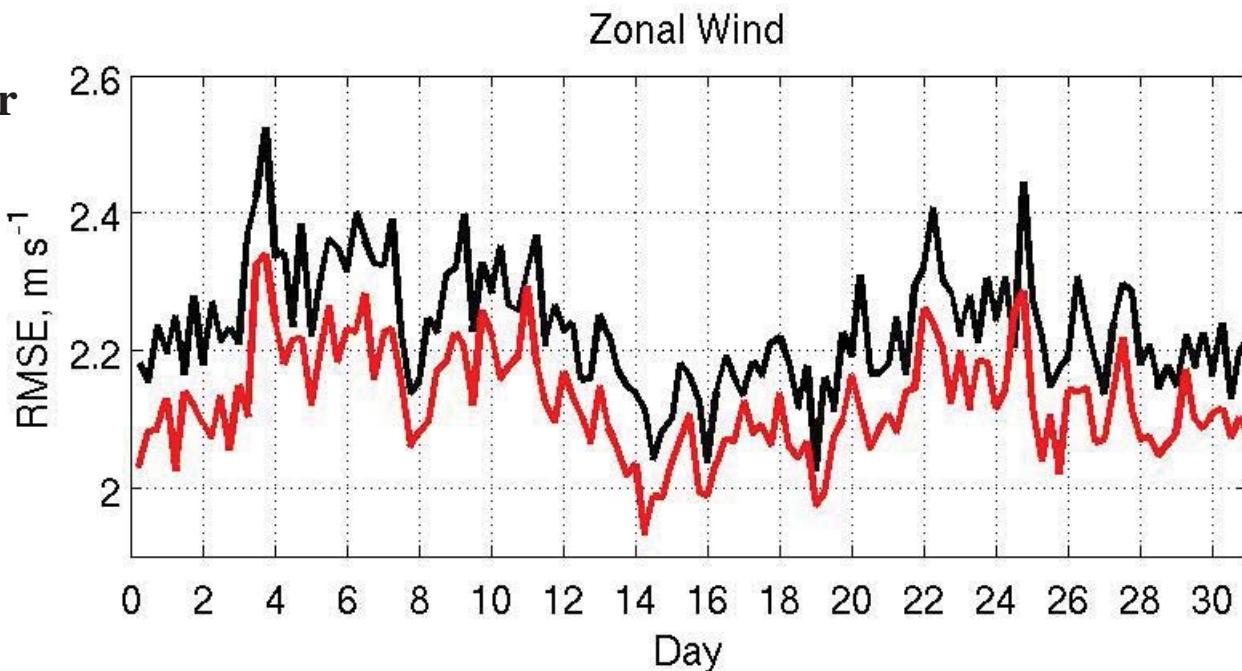
Impacts of 4x daily radiosondes everywhere

Privé, N., R. Errico, and K.-S. Tai, 2014: The impact of increased frequency of rawinsonde observations on forecast skill investigated with an observing system simulation experiment. *Mon. Weather Rev.*, **142**, 1823-1834.

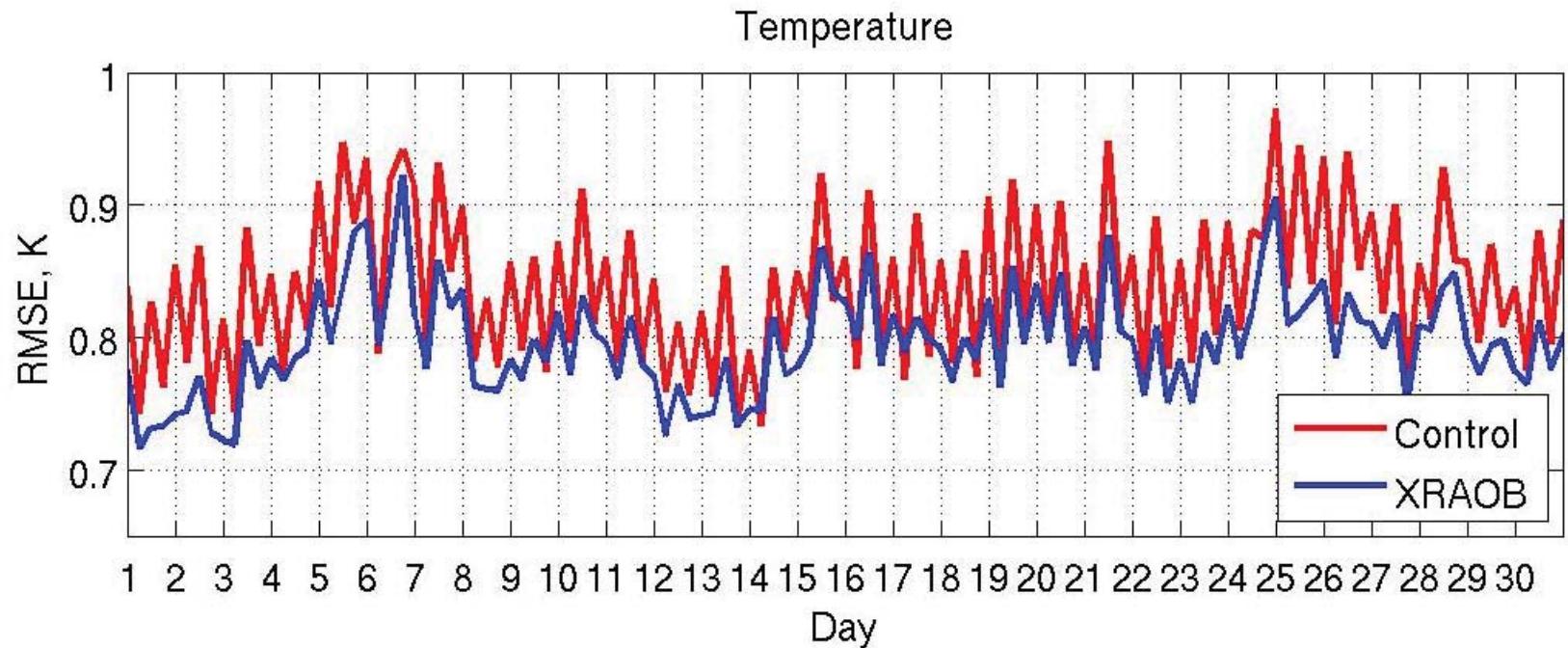
Average over
July
20N-60N
312 hPa



Analysis Error
Background Error

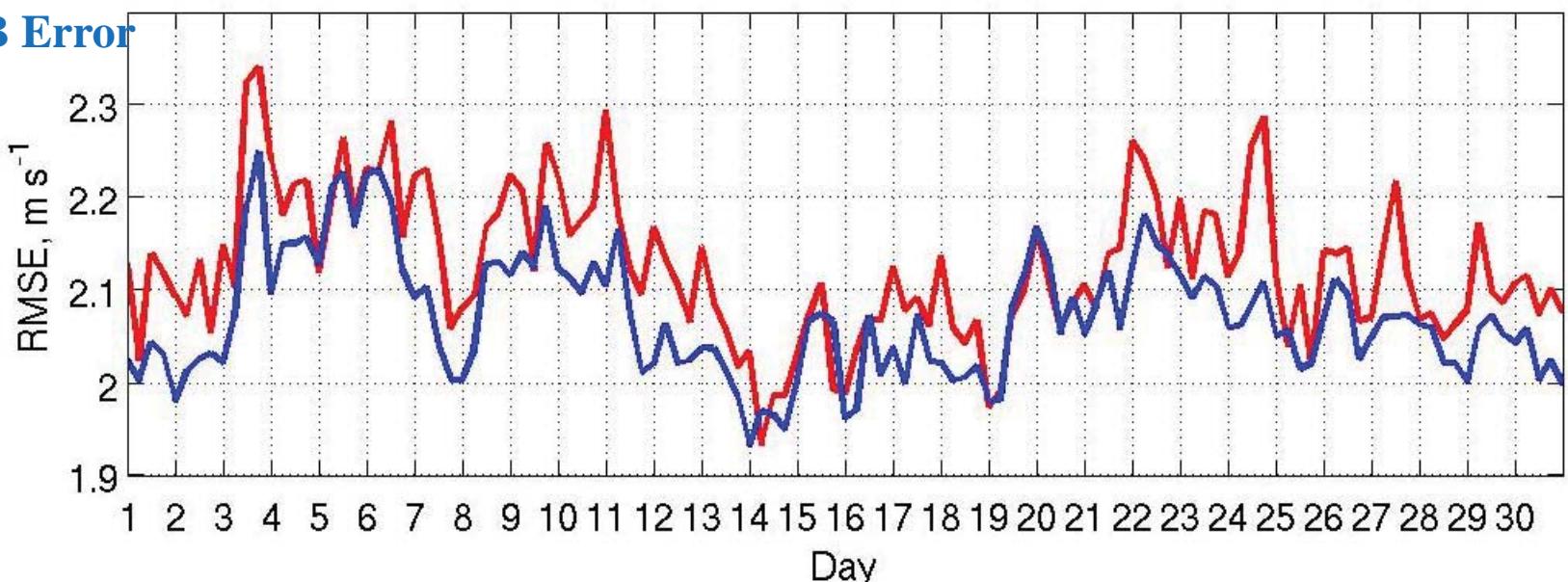


Average over
July
20N-60N
312 hPa



Control Error

Extra RAOB Error

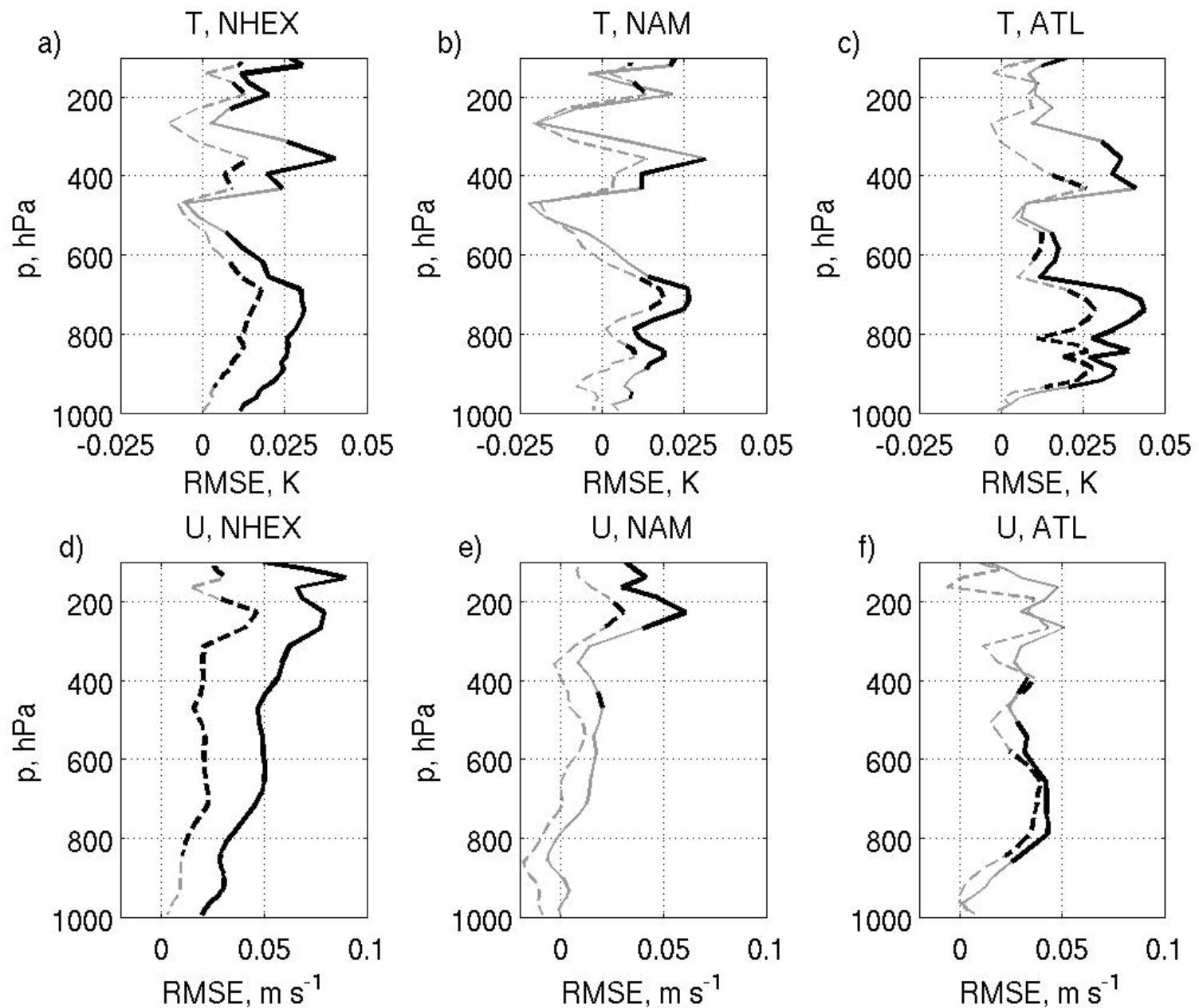


RMSE for control – RMSE for extra RAOBs at forecast hour 24 for 3 regions

Dashed =
Combined
results for
0z and 12z

Solid =
Combined
results for
6z and 18z

Dark =
Pass at 95%
significance

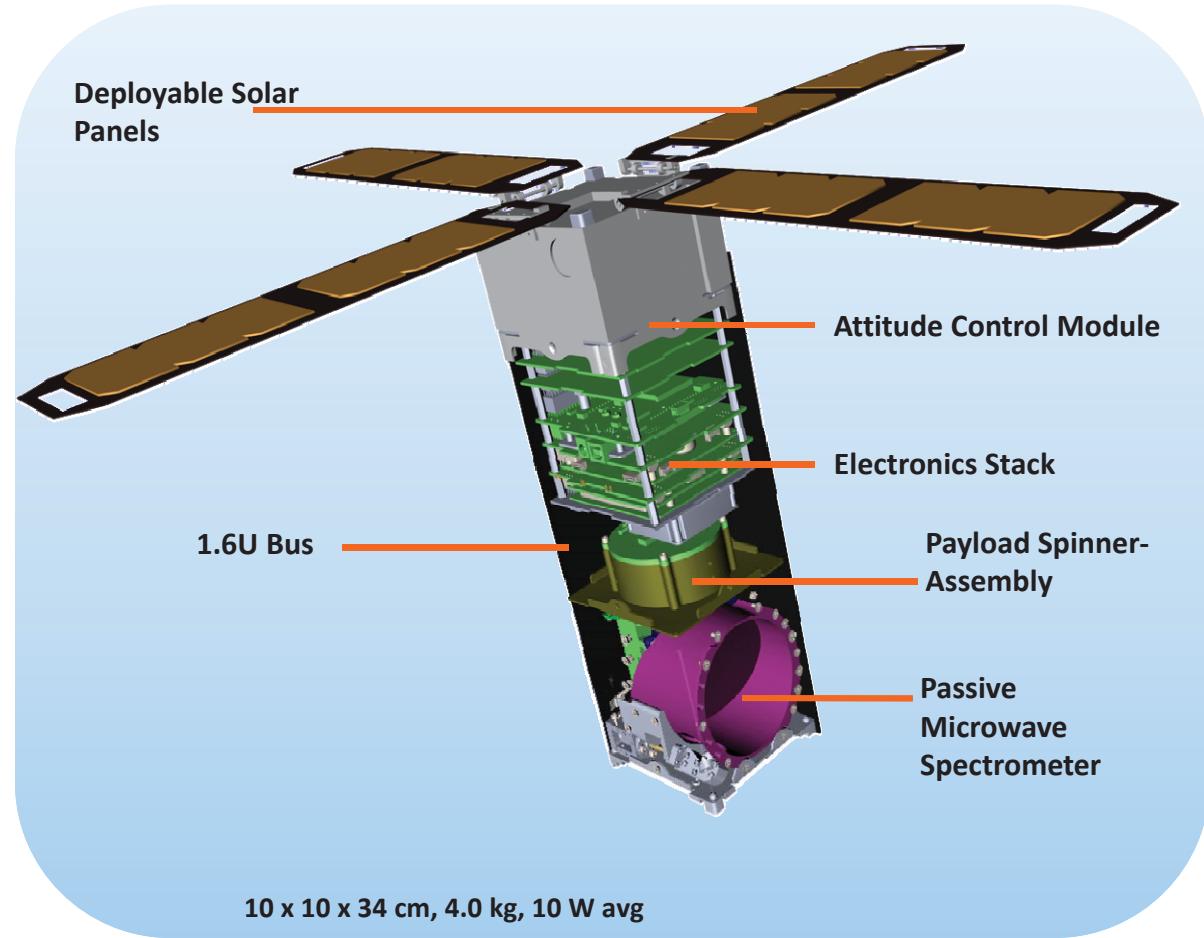


Impacts of Micromas CubeSat

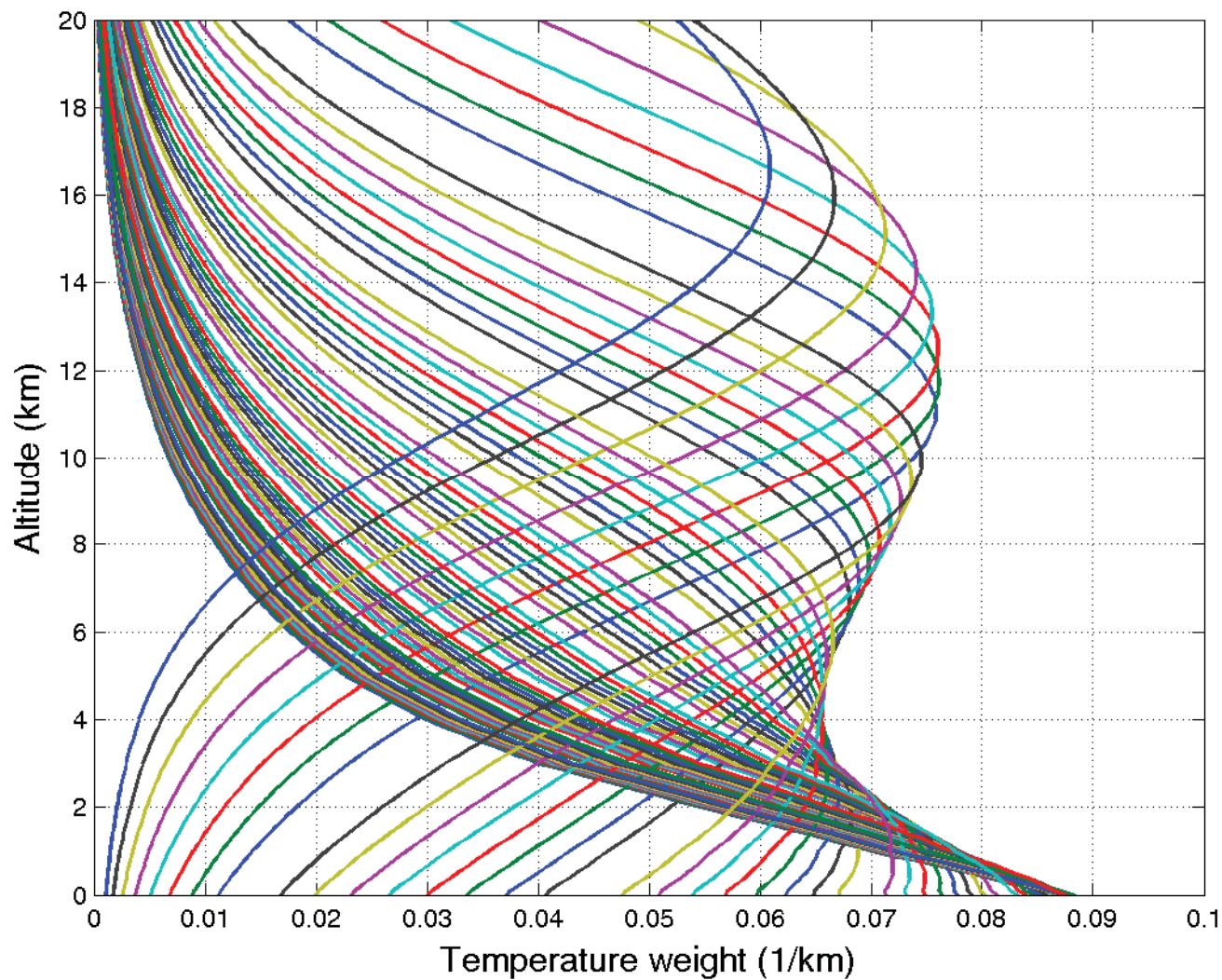
Proposal under review

The MicroMAS CubeSat

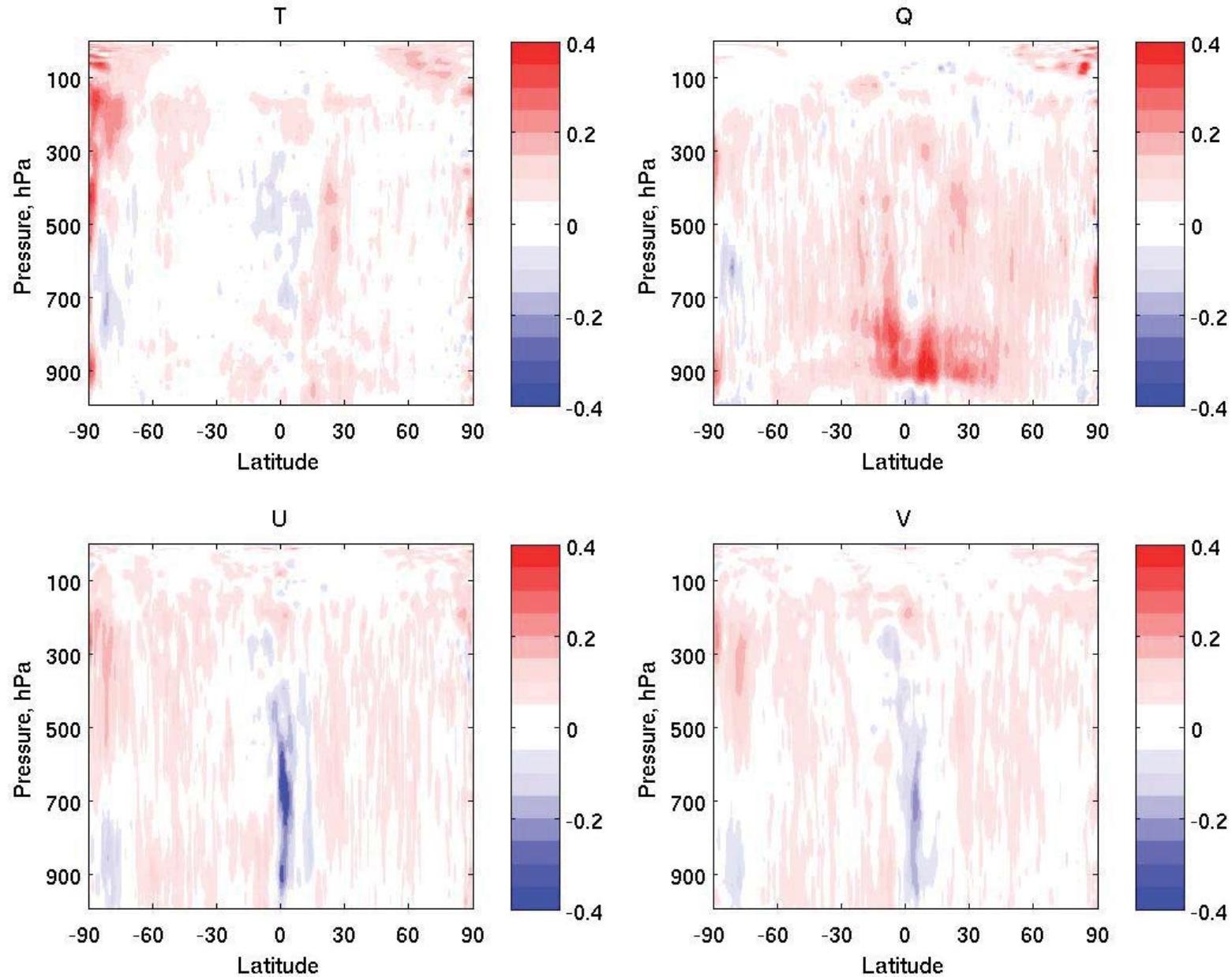
- **MicroMAS Spacecraft**
 - Electronics Stack
 - Scanning Assembly
 - Reaction Wheels
 - Communications Radio
- **MicroMAS Payload**
 - Payload Interface Module
 - Antenna Assembly
 - Receiver Front End
 - Back End Processor
 - Power Conditioning
 - Thermal Management
 - Control & Data Handling



A high-resolution 118-GHz spectrometer provides all-weather measurements of atmospheric temperature and precipitation



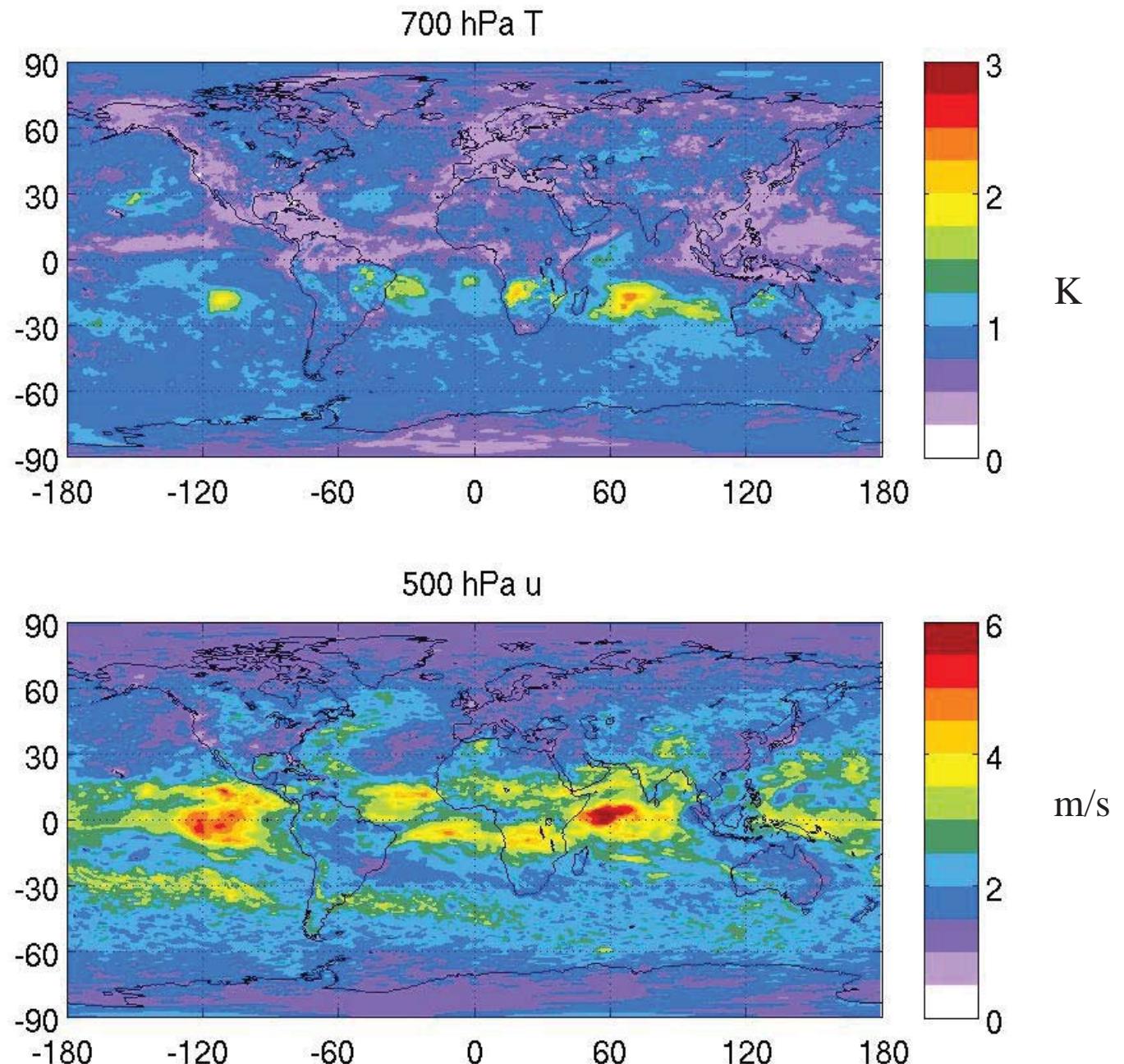
Fractional reduction of analysis error $[ea(\text{without})-ea(\text{with})]/ea(\text{without})$



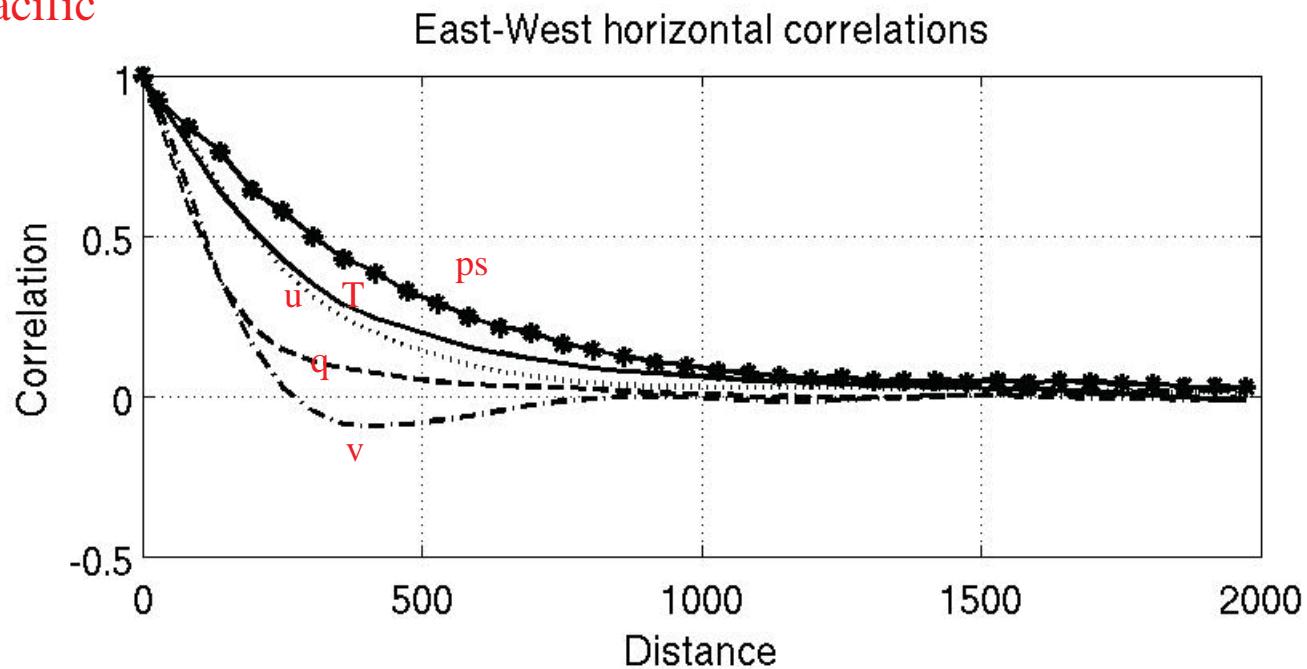
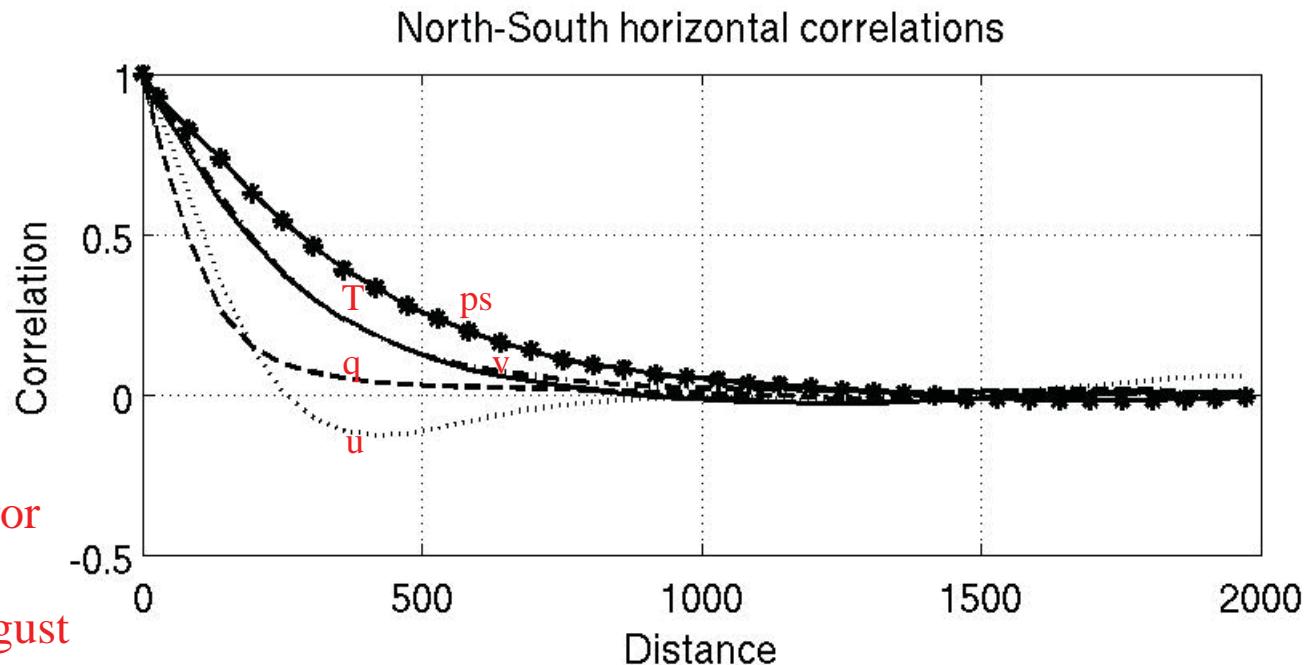
Estimate of analysis error characteristics

Errico, R. M., N. C. Privé, 2014: An estimate of some analysis error statistics using the GMAO observing system simulation framework.
Quart. J. Roy. Meteorol. Soc., **140**, 1005-1012.

Temporal standard deviations of analysis errors for July-August

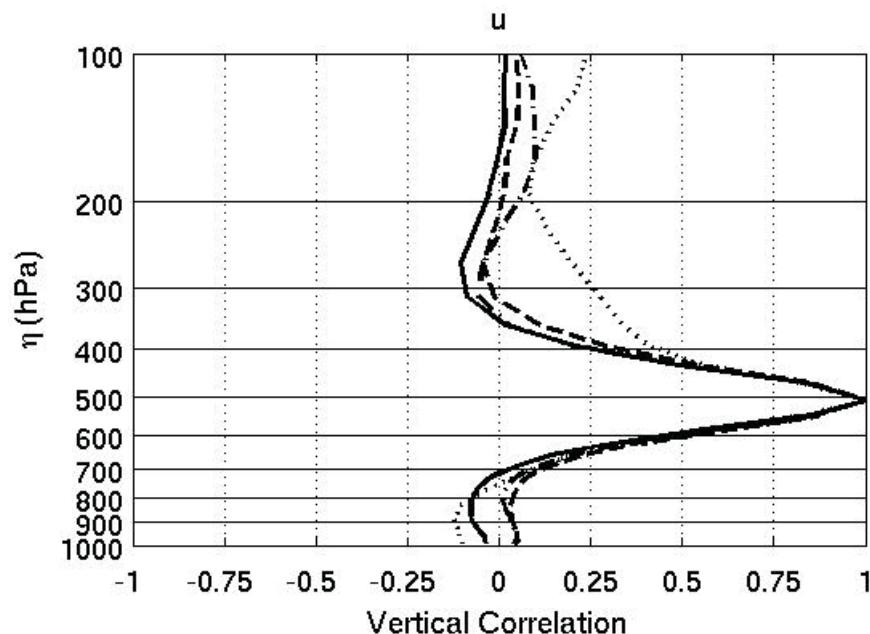
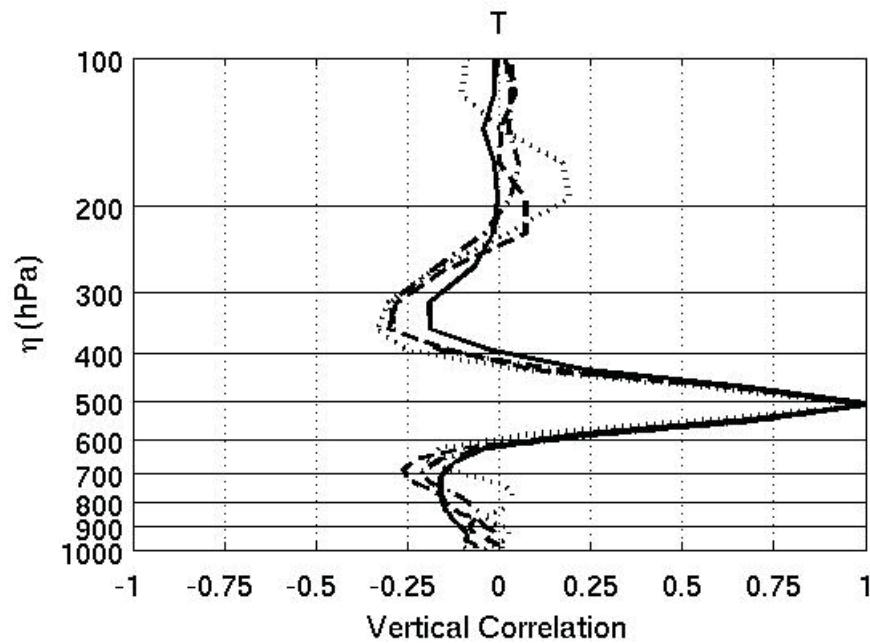


Analysis error
correlations
for July-August
for North-Pacific
region

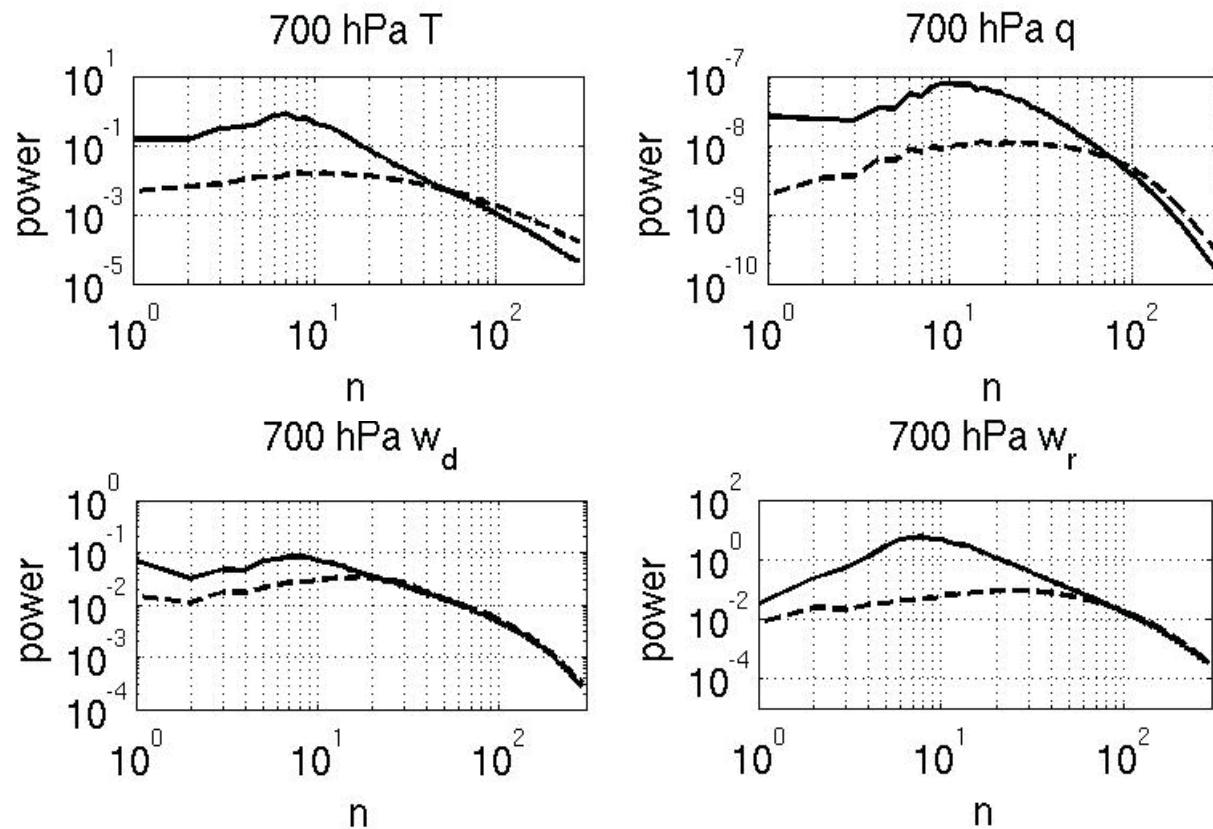


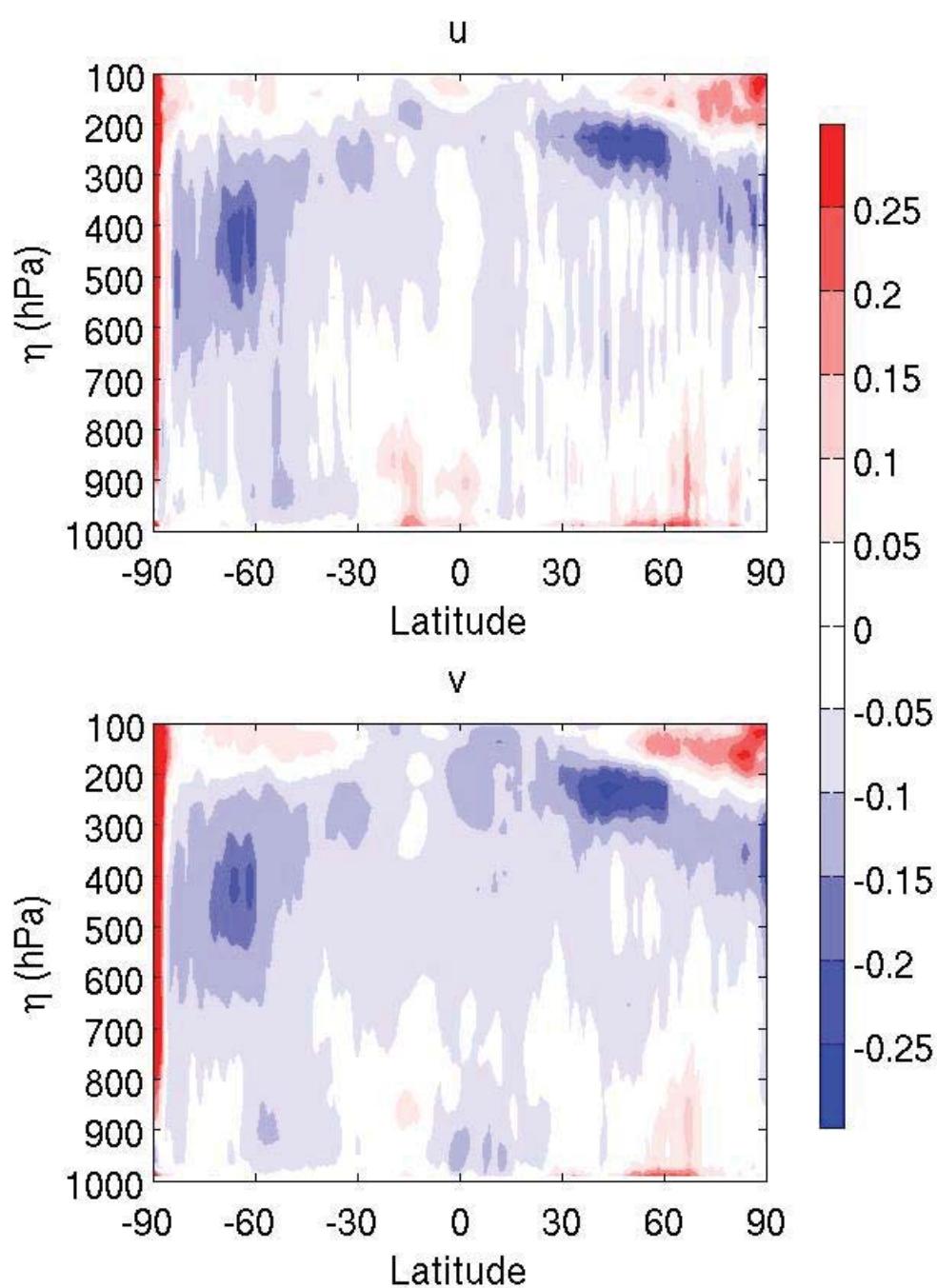
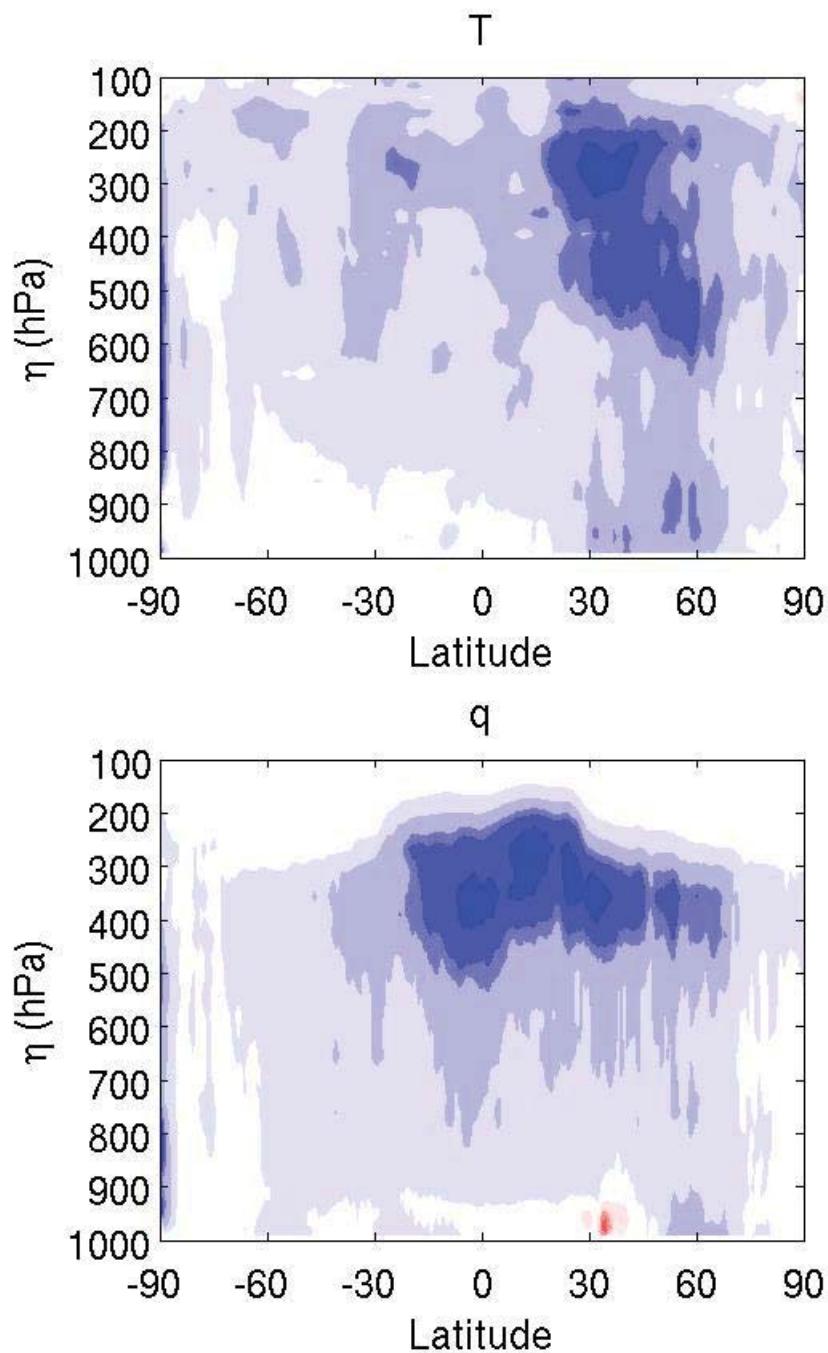
Vertical correlations
of analysis error
for July-August
for various regions

CONUS = solid
North PAC= dashed
Trop PAC= dotted
South PAC= dot-dashed



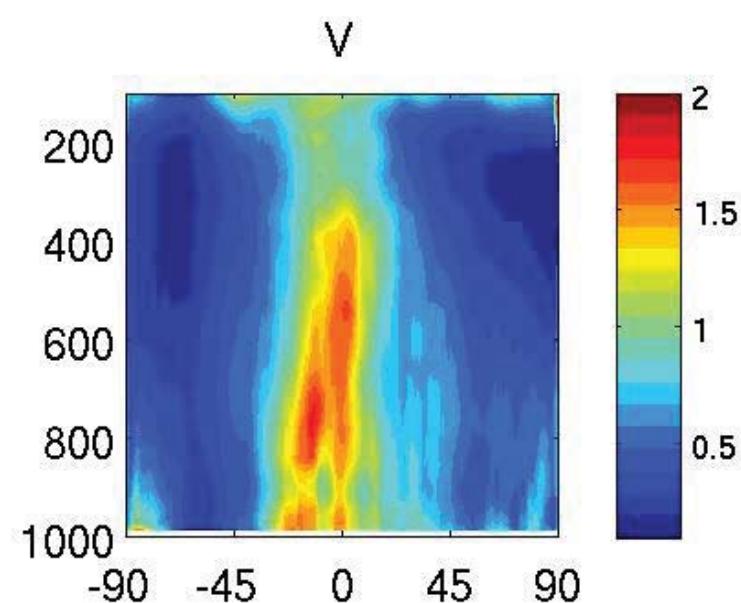
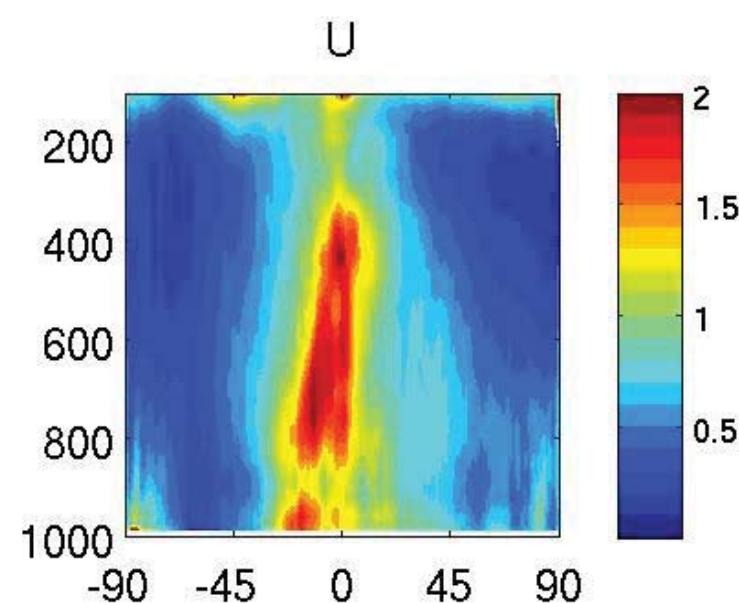
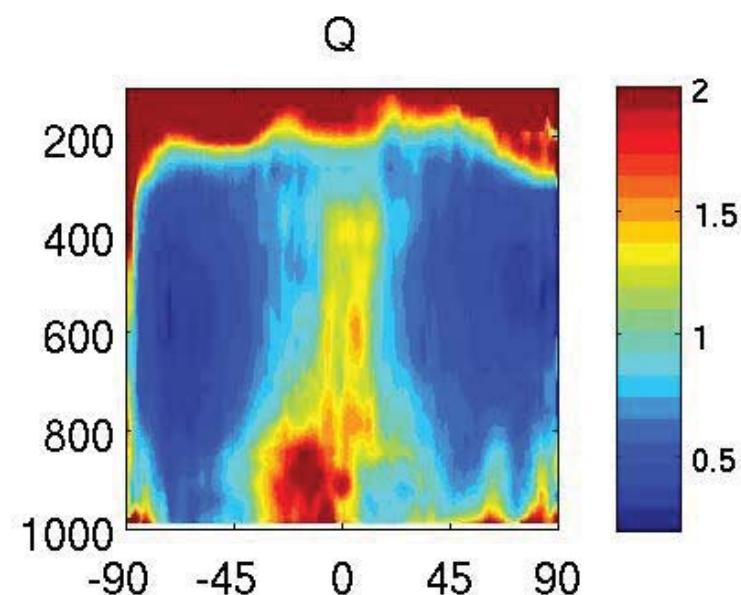
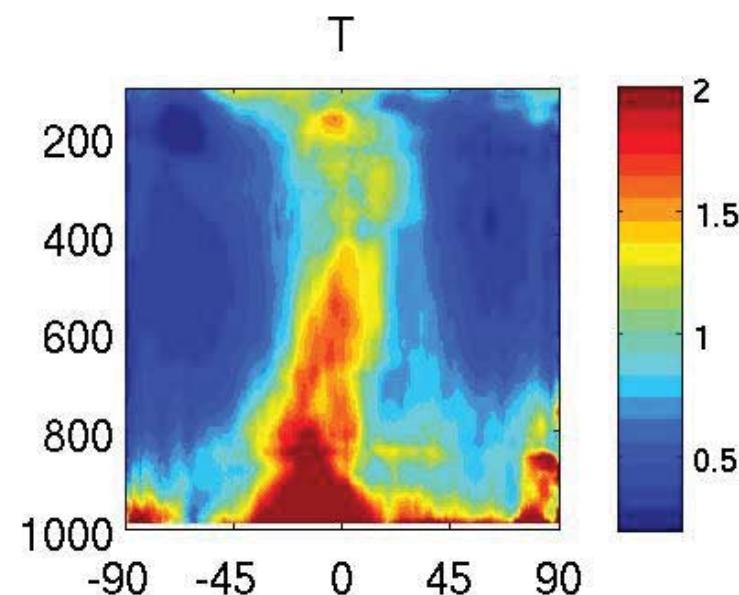
Application: Characterization of analysis error
Power spectra of analysis and analysis error fields on eta-surfaces

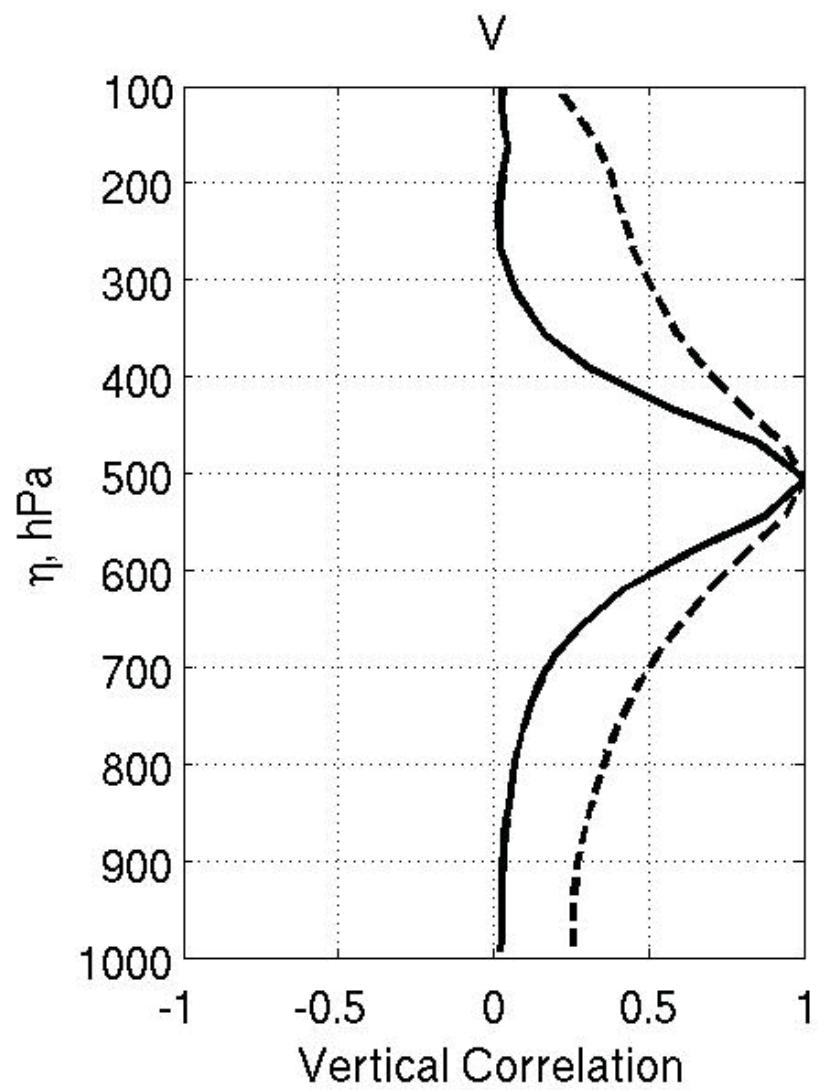
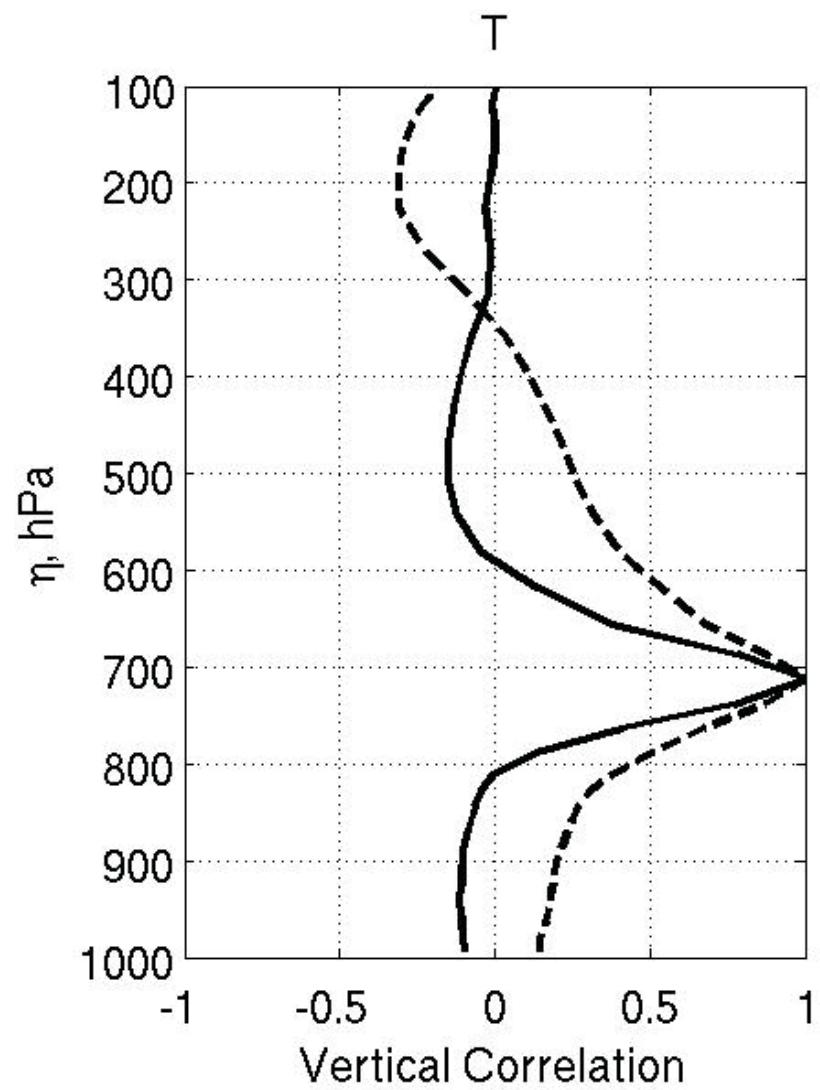


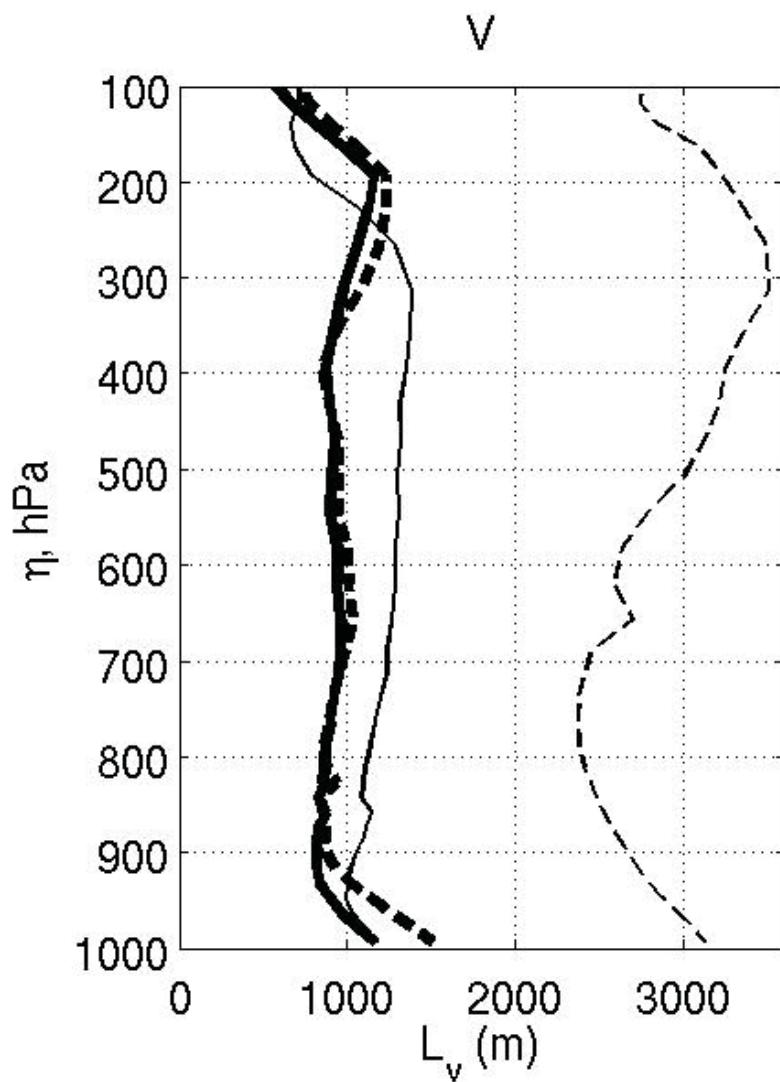
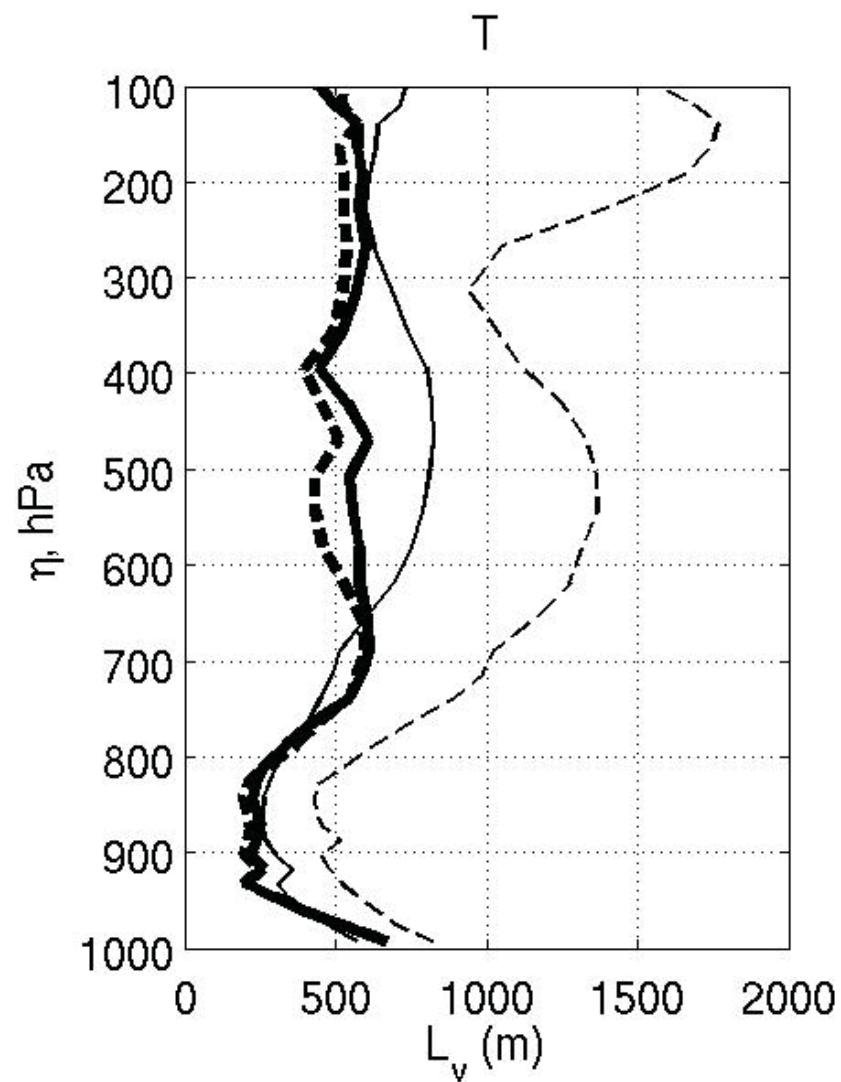


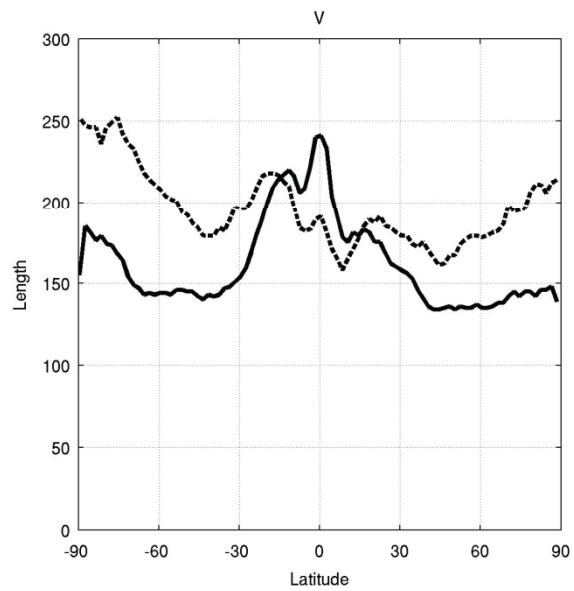
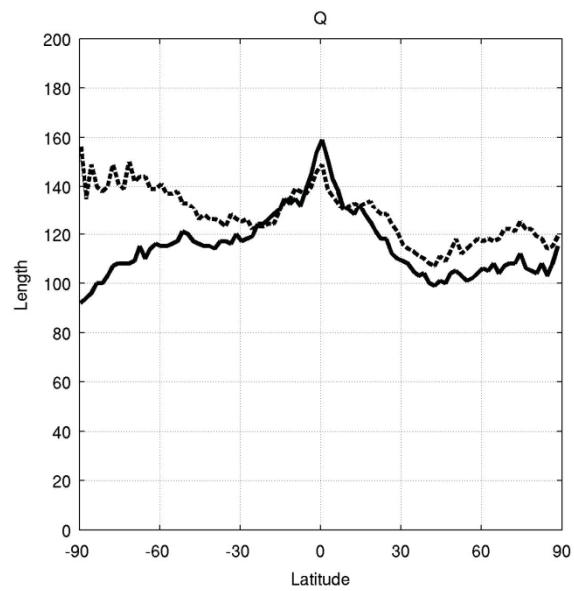
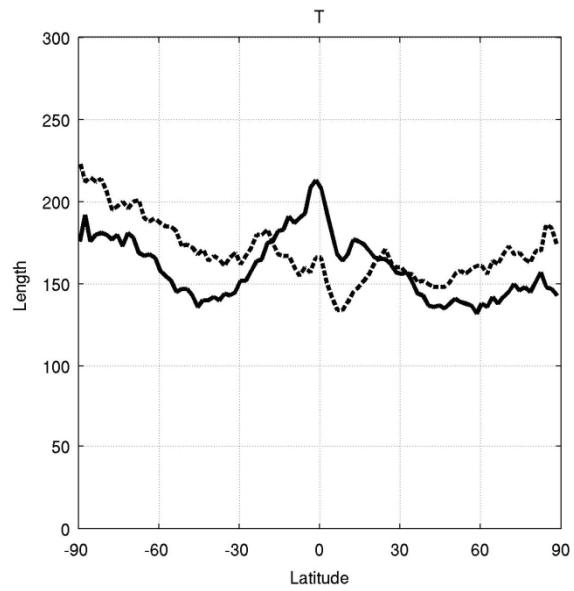
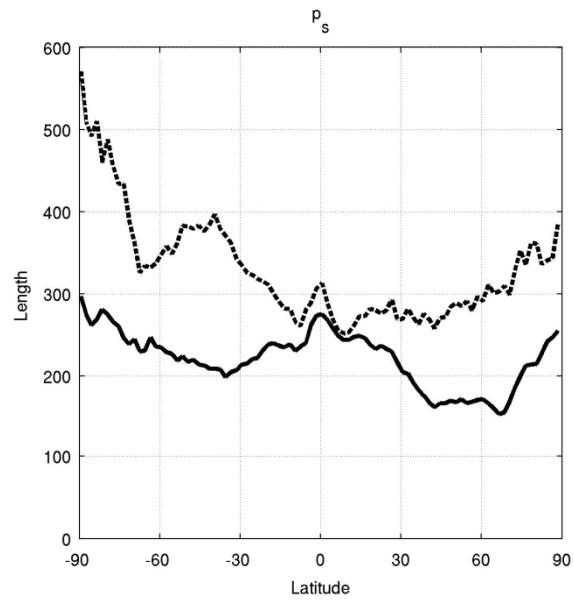
Examination of the “NMC Method”

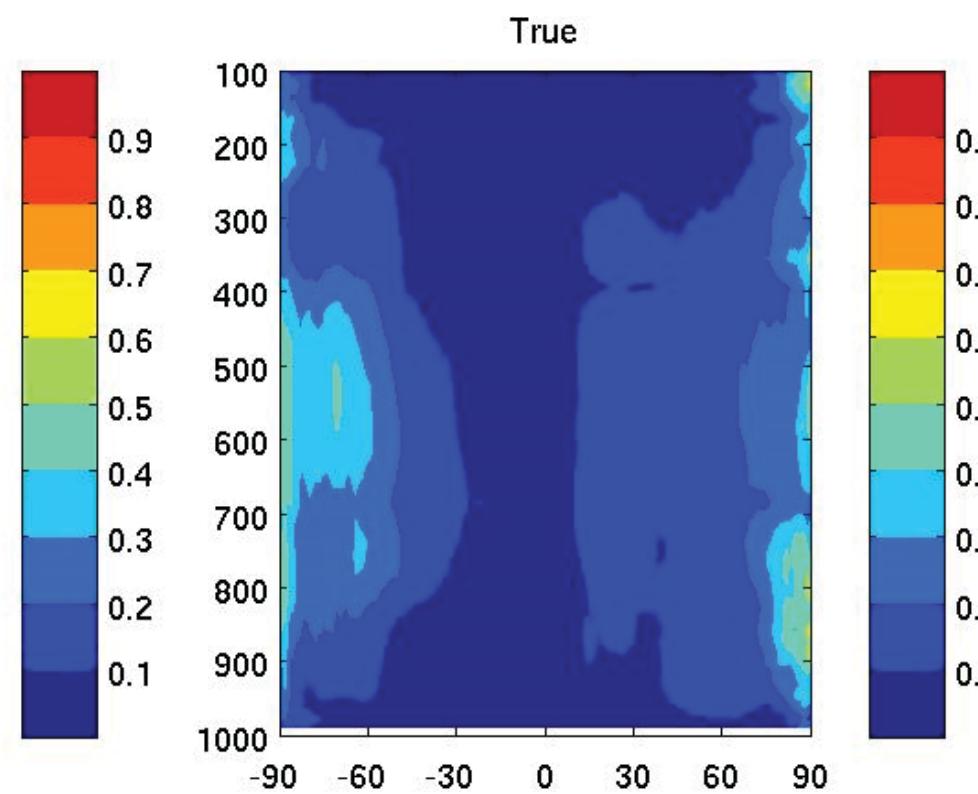
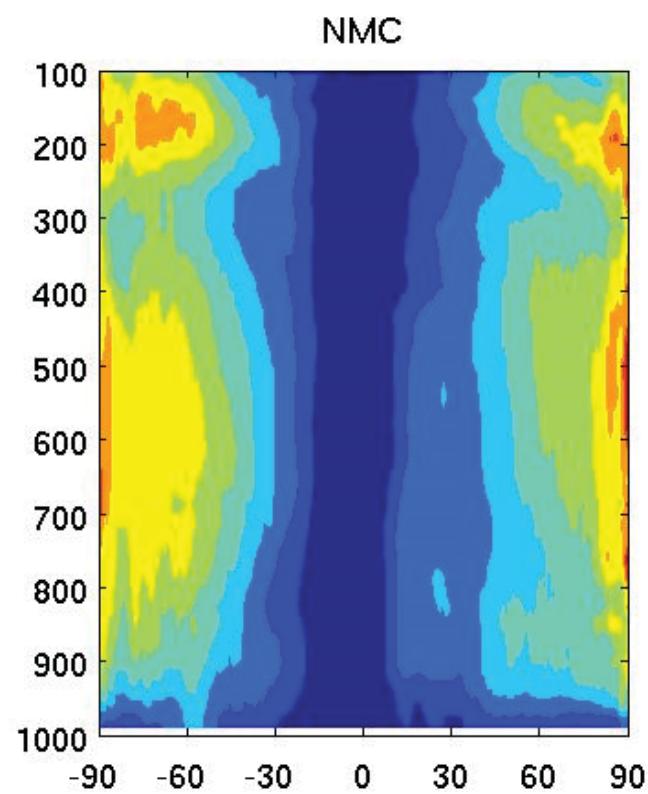
Errico, R. M., N. C. Privé, W. Guo, 2014: Use of an OSSE to evaluate background error covariances estimated by the “NMC method.” *Quart. J. Roy. Meteorol. Soc.*, in press.





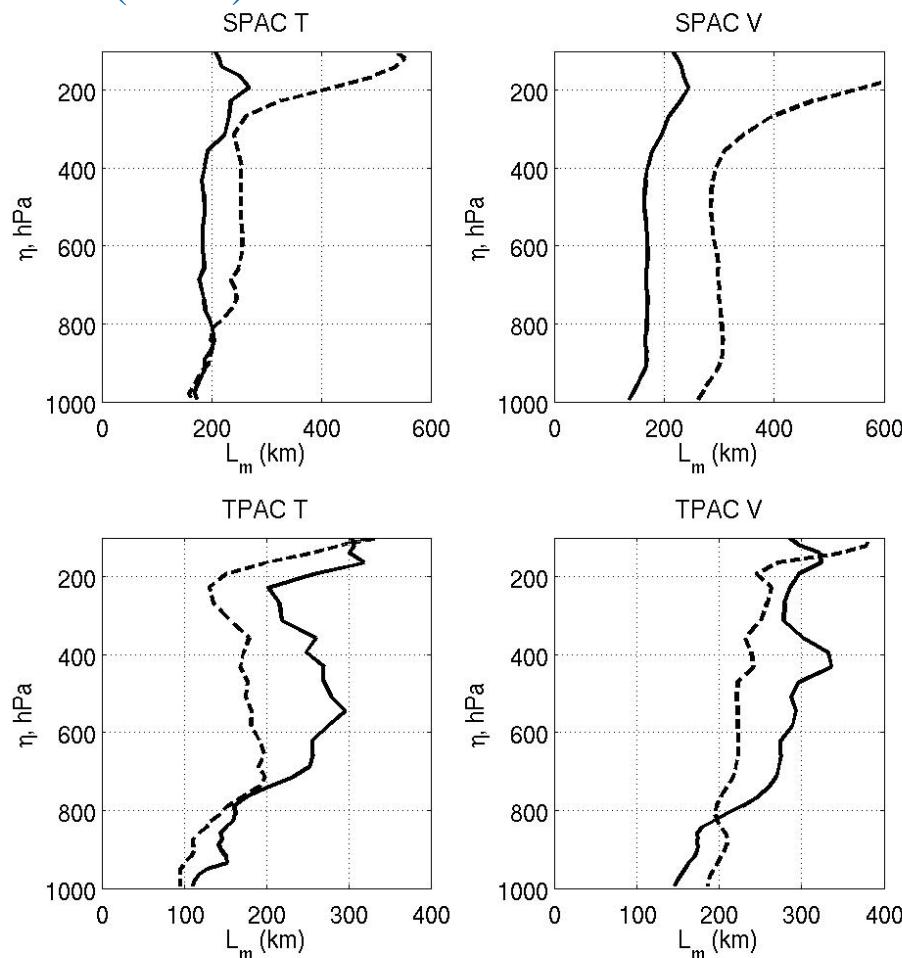






Application: Evaluation of “NMC Method”
Comparison of meridional correlation length scales for
true Bkg error (solid) versus 48-24 hour forecast differences (dashed)

South
Pacific

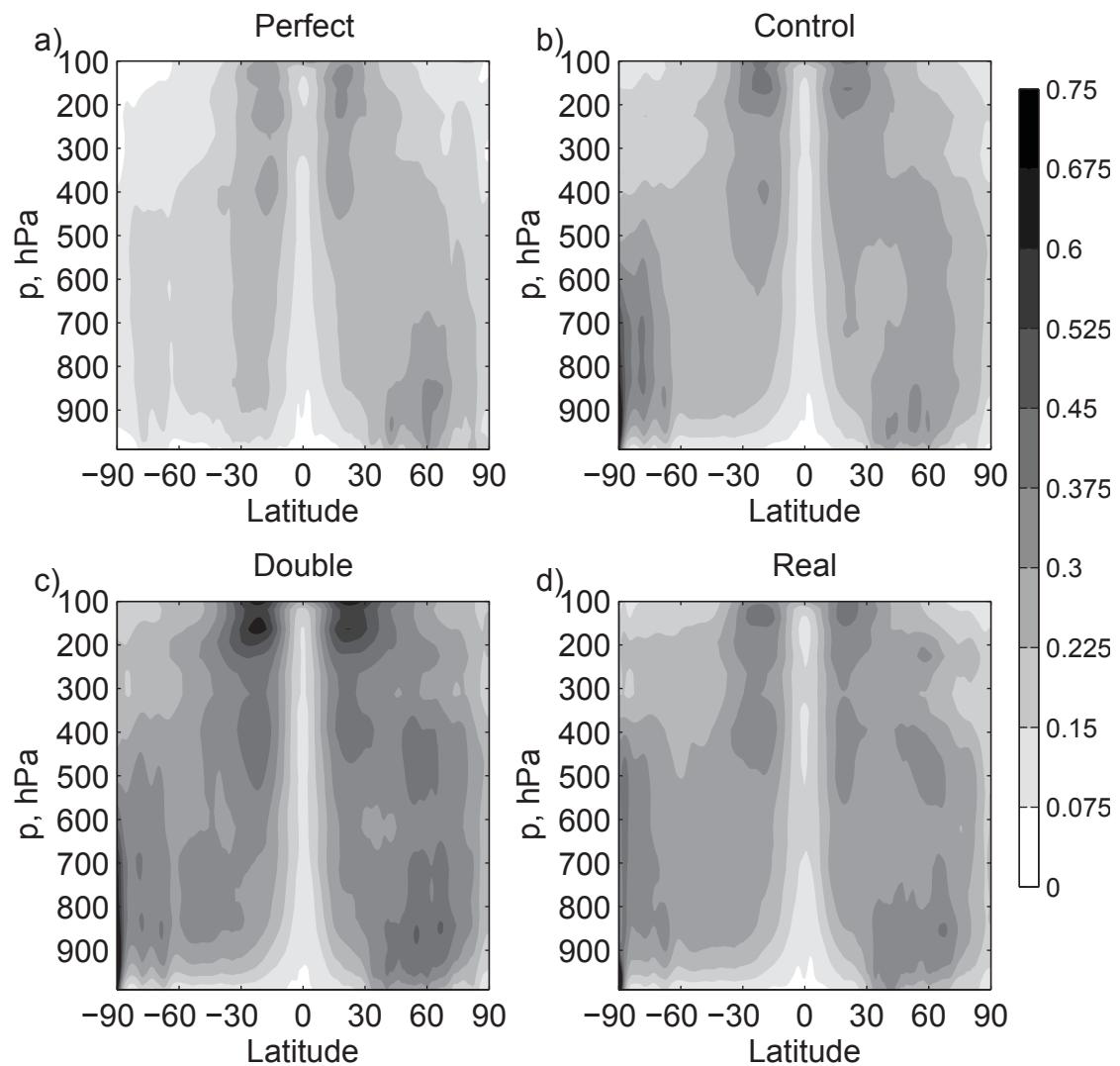


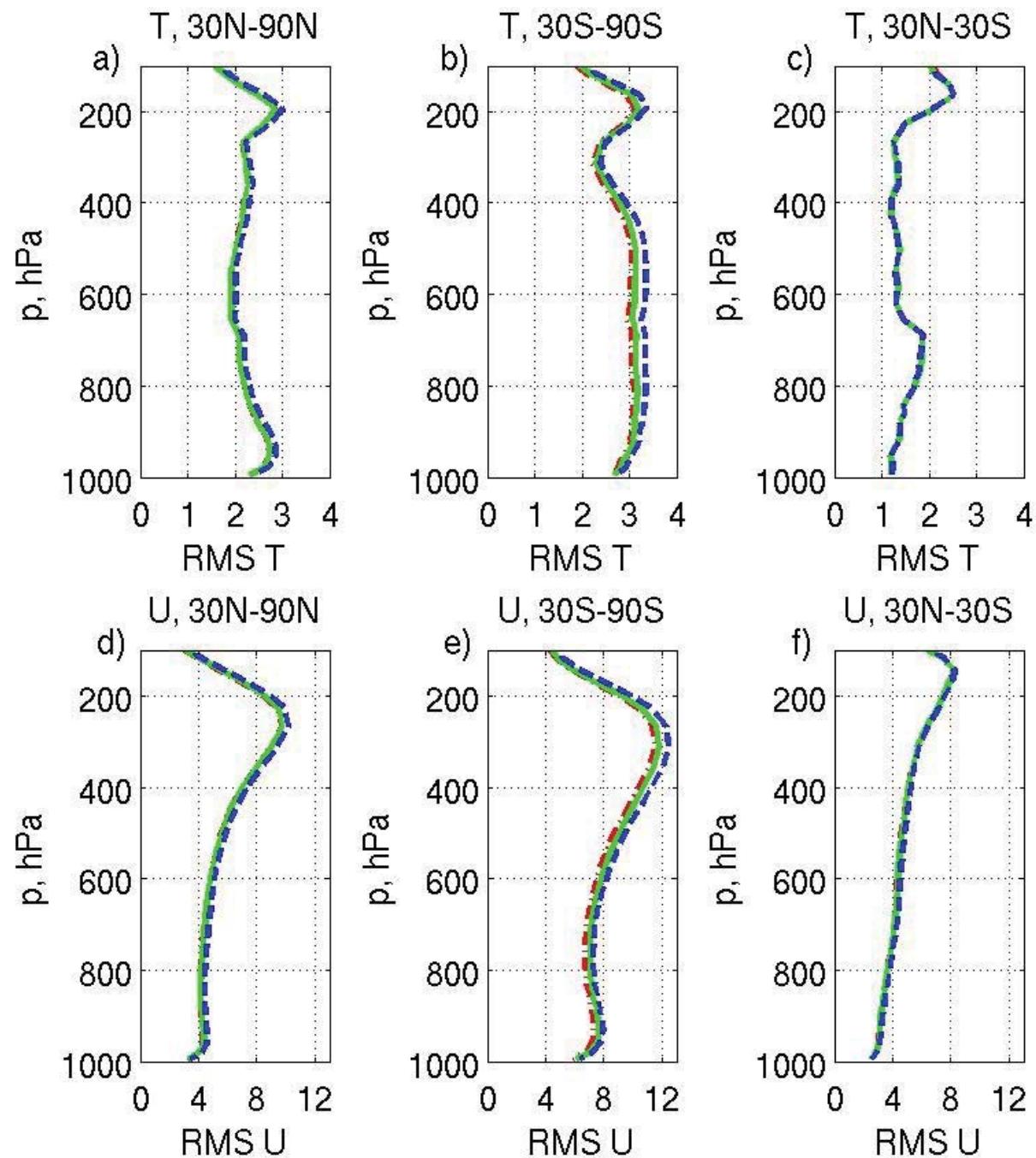
Tropical
Pacific

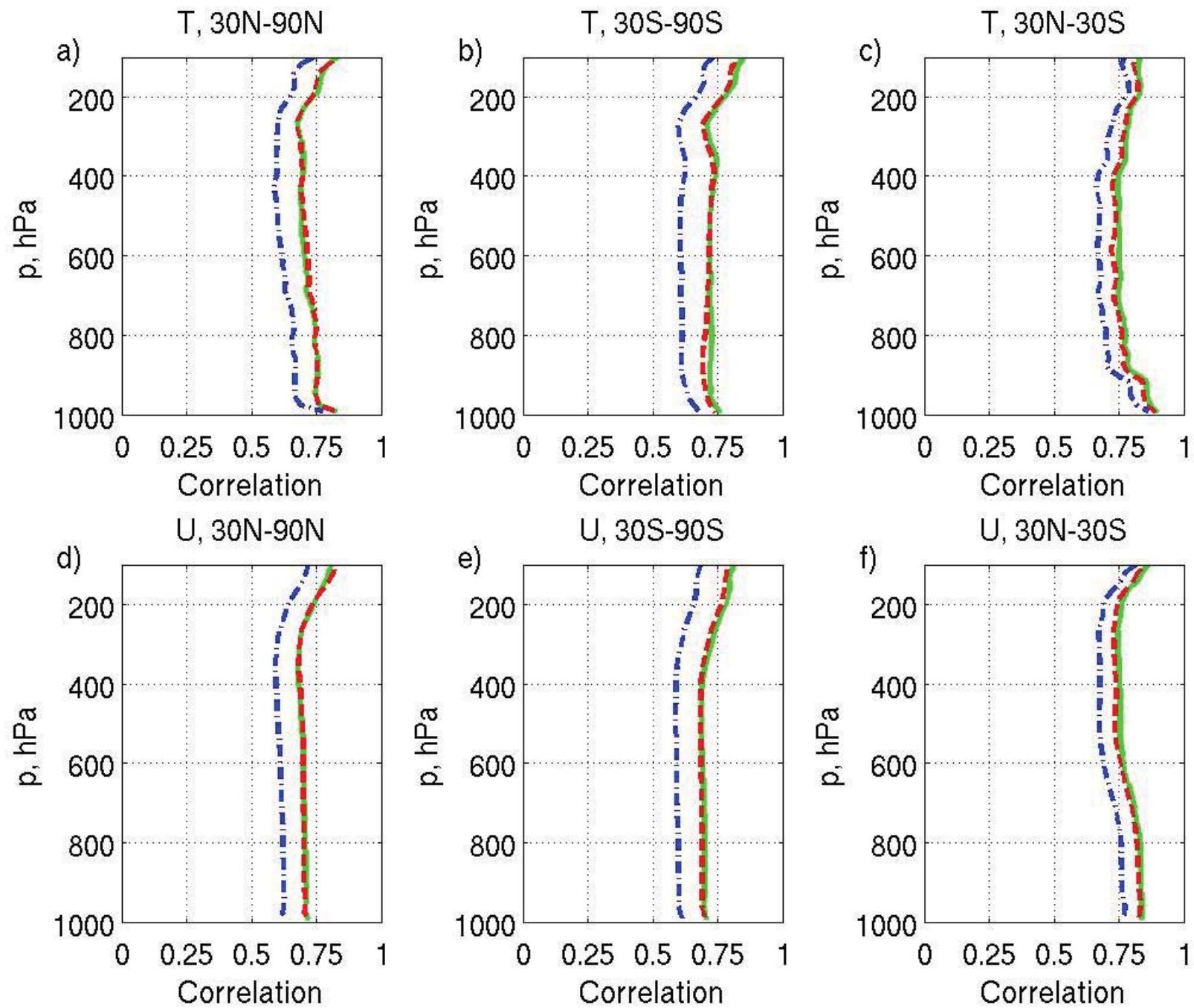
Errico, R. M., N. C. Privé, W. Guo, 2013: Use of an OSSE to evaluate background error covariances estimated by the “NMC method.” *Quart. J. Roy. Meter. Soc.*, submitted.

Effects of observation errors on analysis and forecasts

Privé, N. C., R. M. Errico, K.-S. Tai, 2013: The influence of observation errors on analysis error and forecast skill investigated with an observing system simulation experiment. *J. Geophys. Res. – Atmos.*, **118**, 5332-5346.



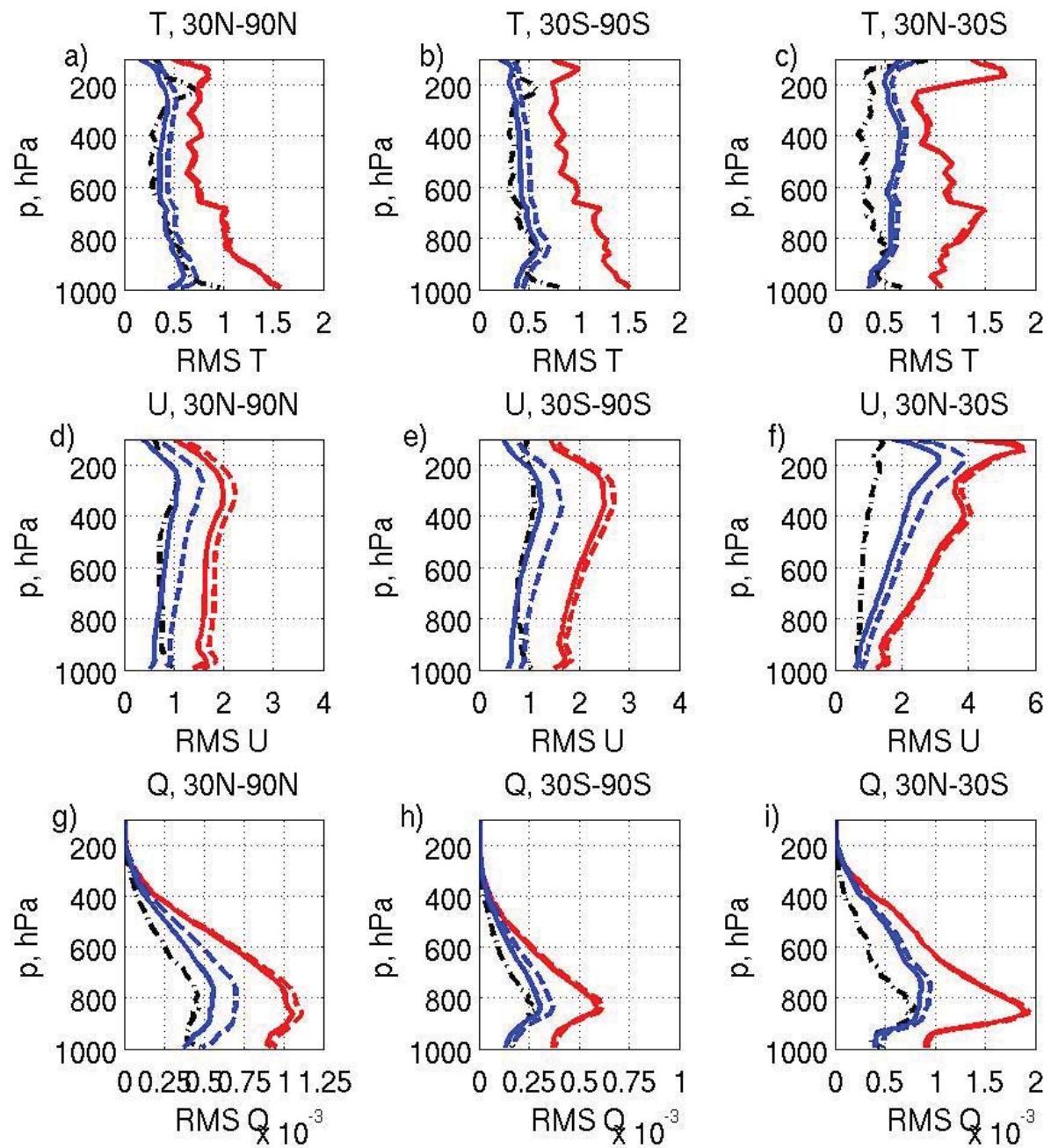


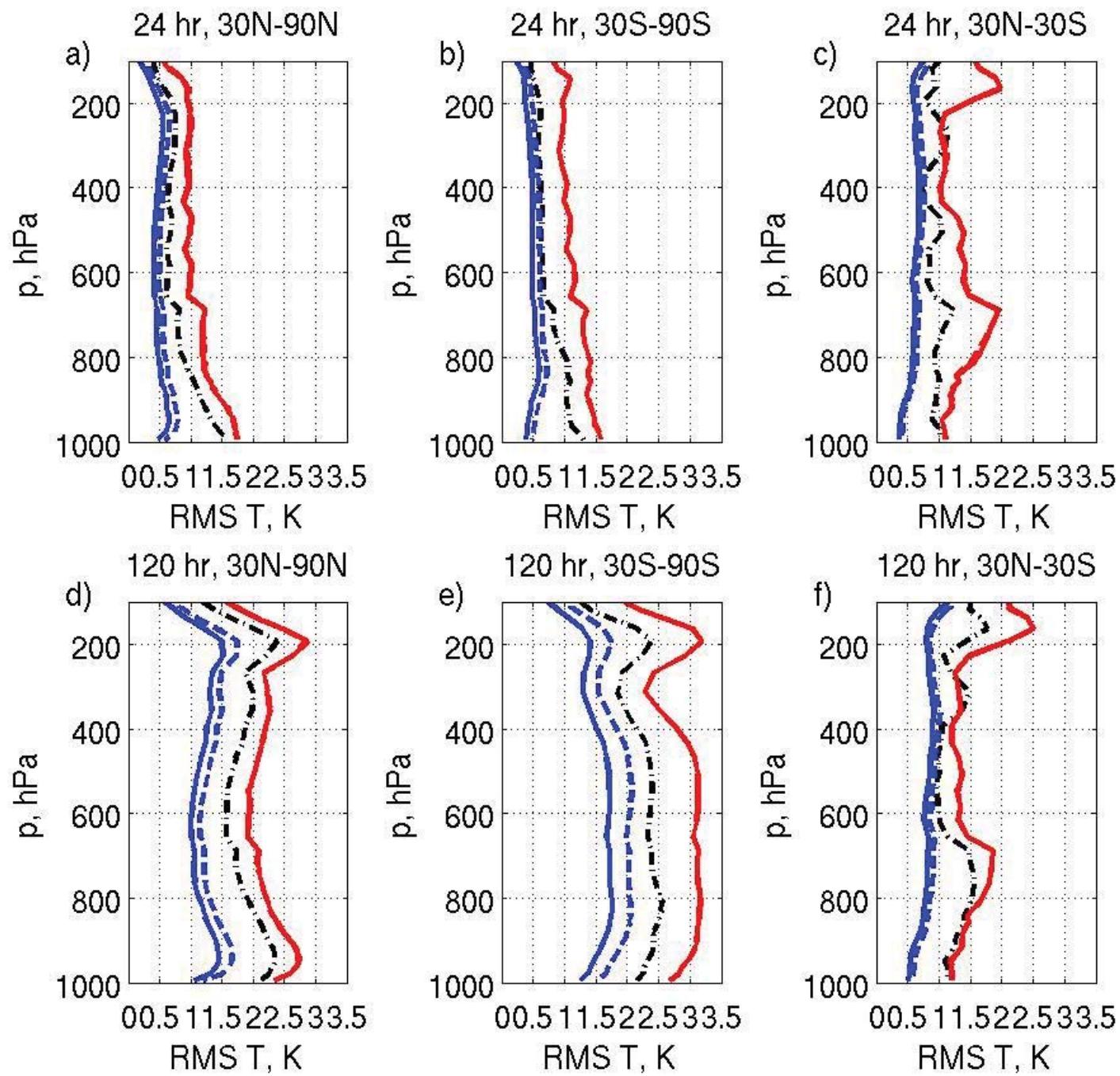


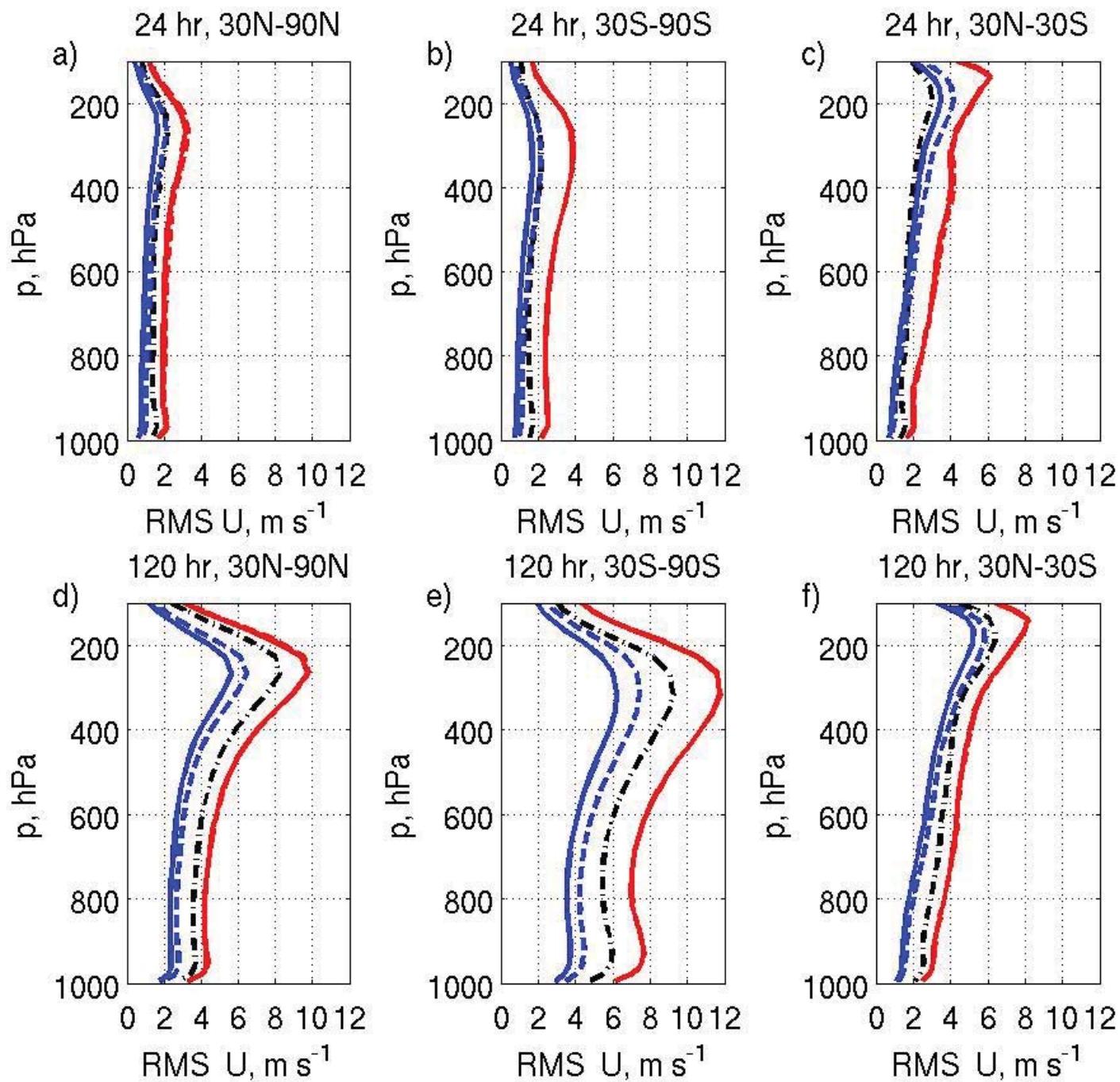
Effects of model and observation errors

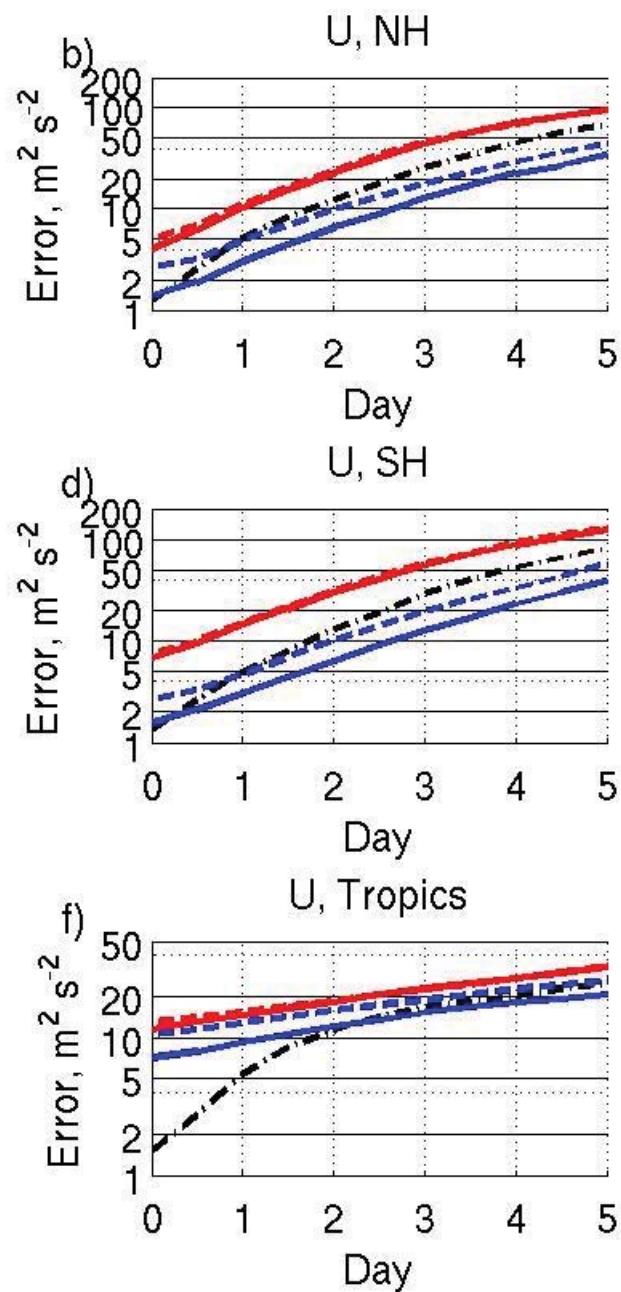
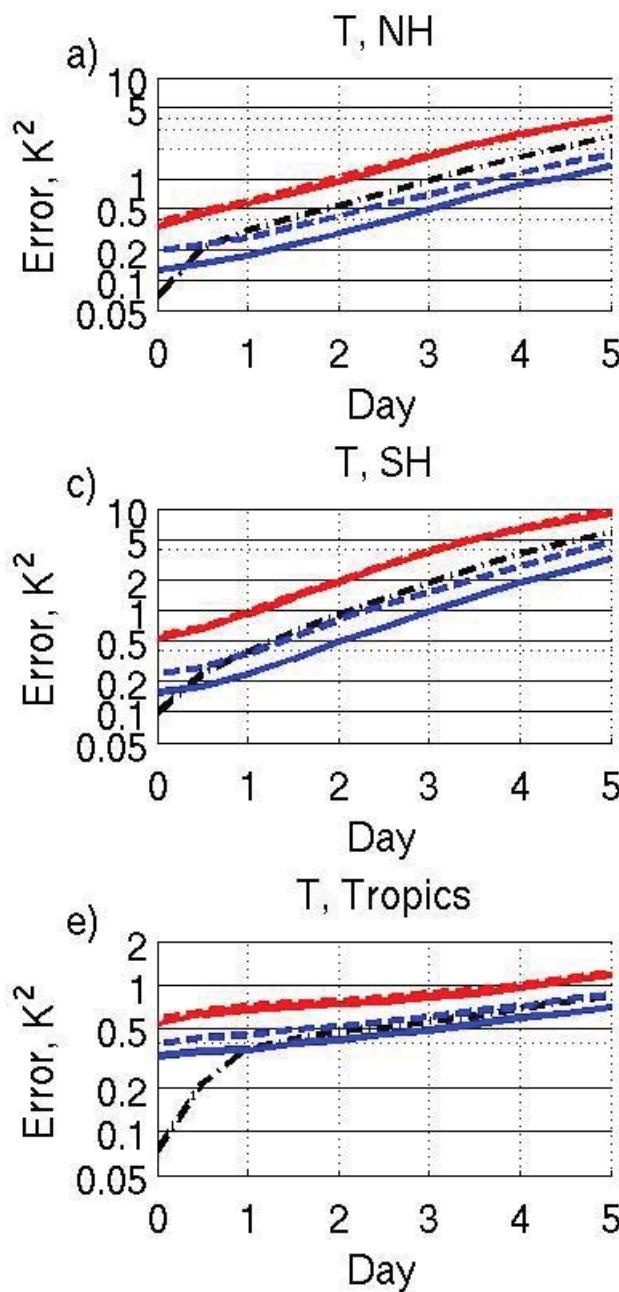
Privé, N. C., R. M. Errico, K.-S. Tai, 2013: The influence of observation errors on analysis error and forecast skill investigated with an observing system simulation experiment. *J. Geophys. Res. – Atmos.*, **118**, 5332-5346.

Privé, N. C., and R. M. Errico, 2013. The role of model and initial condition error in numerical weather forecasting investigated with an observing system simulation experiment. *Tellus*, **65A**, 21740.

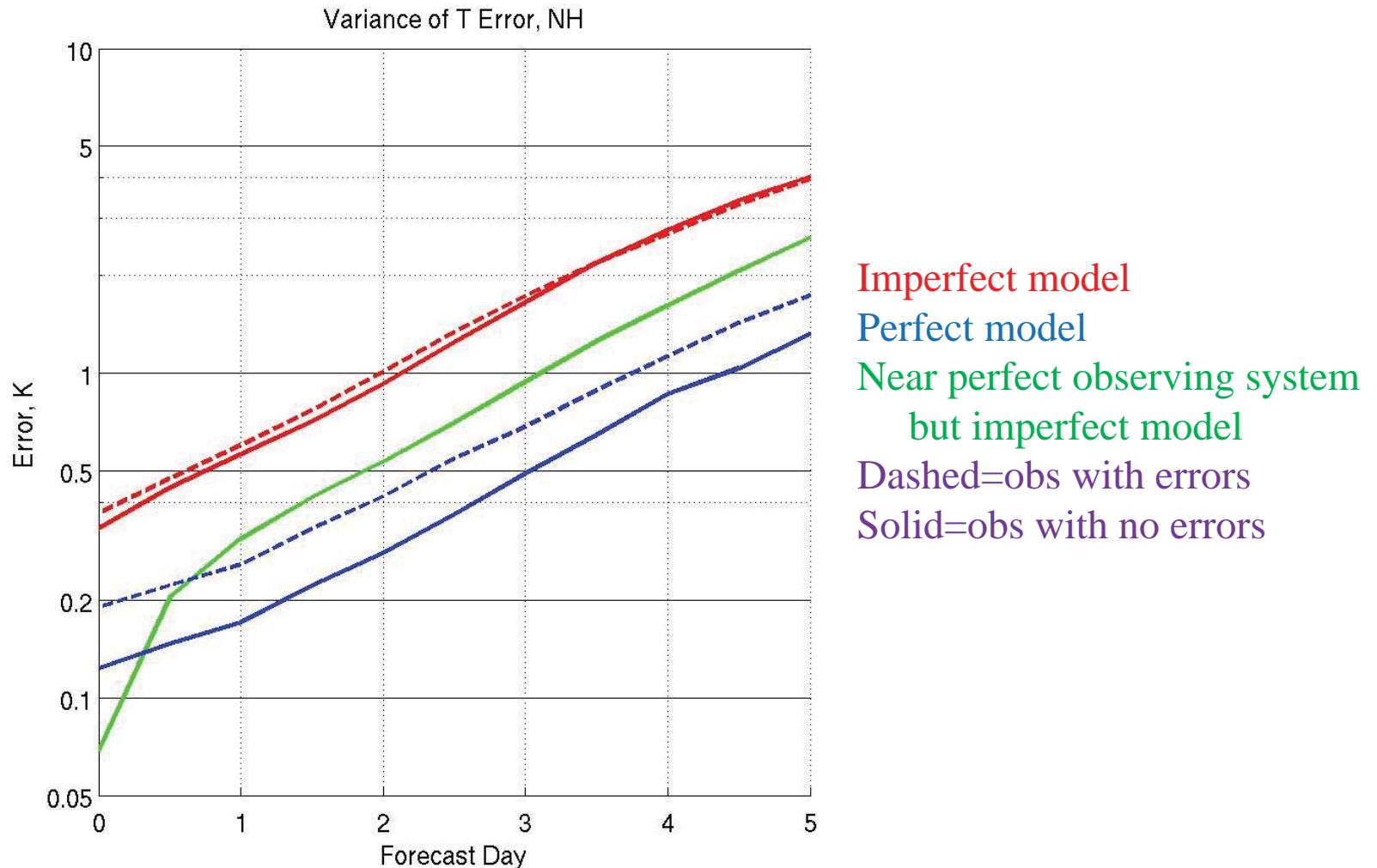








Application: Effects of model and observation errors

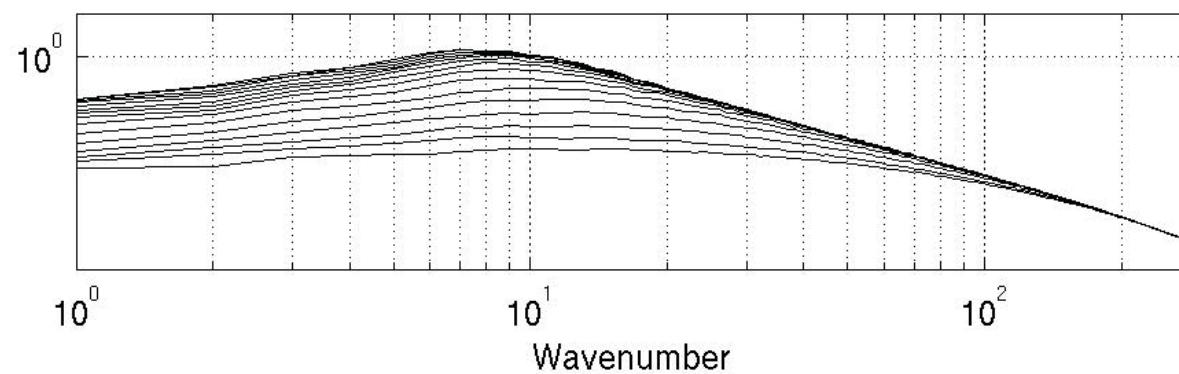


Privé, N. C., R. M. Errico, K.-S. Tai, 2013: The influence of observation errors on analysis error and forecast skill investigated with an observing system simulation experiment. *J. Geophys. Res.*, in press.

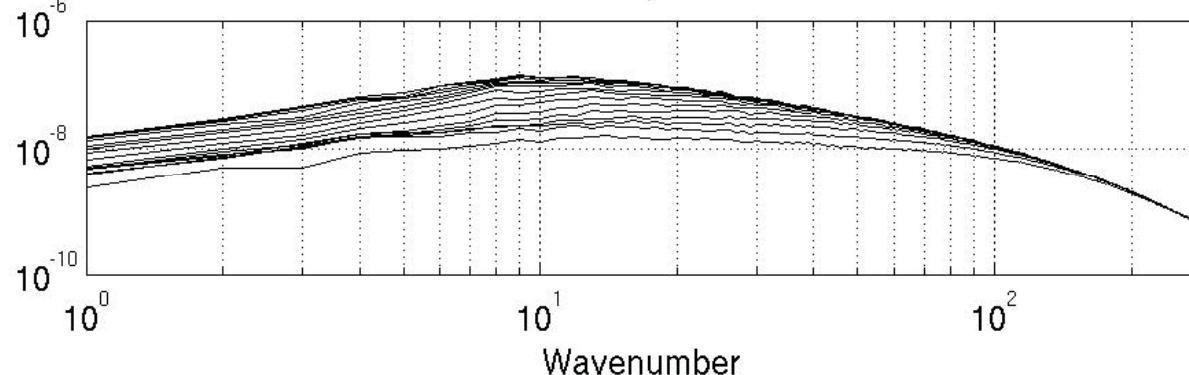
Examination of predictability

Manuscript in preparation (Privé and Errico)

T



q



Wind

